

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

0 268 237
A2

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 87116861.3

(51) Int. Cl. 4: **G01N 1/10**, **G01N 35/00**,
G01F 11/02

(22) Date of filing: 16.11.87

(30) Priority: 17.11.86 US 931476

(43) Date of publication of application:
25.05.88 Bulletin 88/21

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

(71) Applicant: **ABBOTT LABORATORIES**

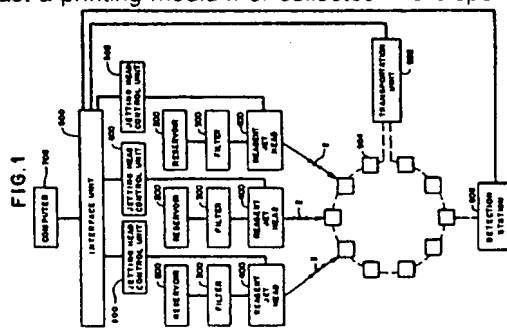
Abbott Park Illinois 60064(US)

(72) Inventor: **Hayes, Donald J.**
2012 Tampicko Drive
Plano Texas 75075(US)
Inventor: **Wallace, David B.**
9929 Wood Forest
Dallas Texas 75243(US)
Inventor: **Verlee, Donald J.**
563 Drake Street
Libertyville Illinois 60048(US)
Inventor: **Houseman, Kenneth R.**
1520 S. Main Street
Racine Wisconsin 53403(US)

(74) Representative: **Modiano, Guido et al**
MODIANO, JOSIF, PISANTY & STAUB
Modiano & Associati Via Meravigli, 16
I-20123 Milan(IT)

(54) **Apparatus and process for reagent fluid dispensing and printing.**

(57) A system for printing and dispensing chemical reagents in precisely controlled volumes onto a medium at a precisely controlled location. A jetting tube, comprising an orifice at one end and a fluid receiving aperture at the other end, is concentrically mounted within a cylindrical piezo-electric transducer. The fluid receiving aperture is connected to a reservoir containing a selected reagent by means of a filter. The reservoir is pressurized by a regulated air supply. An electrical signal of short duration is applied to the transducer. The pulse causes the transducer and the volume defined by the jetting tube to expand, thereby drawing in a small quantity of reagent fluid. The cessation of the pulse causes the transducer and the volume of the jetting tube to de-expand, thereby causing at least a substantially uniformly sized droplet of reagent fluid to be propelled through the orifice. The droplet may be directed to impact a printing medium or collected in a dispensing receptacle.



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APPARATUS AND PROCESS FOR REAGENT FLUID DISPENSING AND PRINTING

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus and process for dispensing and printing reagent fluids, wherein a transducer is used to propel small quantities of the fluid towards a positioned target.

Diagnostic assays often require systems for metering, dispensing and printing reagent fluids. In the case of metering and dispensing, such systems comprise both manual and automatic means. For purposes of practicality, the present background discussion will focus on the methods of metering and dispensing 100 micro-liter volumes or less.

The manual systems of metering and dispensing include the glass capillary pipet; the micro-pipet; the precision syringe; and weighing instruments. The glass capillary pipet is formed from a precision bore glass capillary tube. The pipet typically comprises a fire blown bulb and a tubular portion fire drawn to a fine point. Fluid is precisely metered by aspirating liquid through the tube into the bulb to a predetermined level indicated by an etched mark. The fluid may then be dispensed by blowing air through the tube.

The micro-pipet typically comprises a cylinder and a spring loaded piston. The travel of the piston is precisely determined by a threaded stop. The distance the piston travels within the cylinder and the diameter of the cylinder define a precise volume. The fluid is aspirated into and dispensed from the micro-pipet in precise quantities by movement of the piston within the cylinder.

The precision syringe generally comprises a precisely manufactured plunger and cylinder with accurately positioned metering marks. The fluid is introduced into and dispensed from the syringe by movement of the plunger between the marks.

Weighing techniques for dispensing fluids often simply involve weighing a quantity of fluid. The density of the fluid may then be used to determine the fluid volume.

Exemplary automatic metering and dispensing systems include the precision syringe pump; the peristaltic pump; and the high performance liquid chromatography (HPLC) metering valve. The precision syringe pump generally comprises a precision ground piston located within a precision bore cylinder. The piston is moved within the cylinder in precise increments by a stepping motor.

The peristaltic pump comprises an elastomeric tube which is sequentially pinched by a series of rollers. Often the tube is placed inside a semi-circular channel and the rollers mounted on the outer edge of a disc driven by a stepping motor. The movement of the rollers against the tubing produces peristaltic movement of the fluid.

The HPLC metering valve comprises a defined length of precision inner diameter tubing. The fluid is introduced into the define volume of the tubing with the valve in a first position and then dispensed from the tubing when the valve is placed in a second position.

All of the above metering and dispensing systems have the disadvantage that the volumes dispensed are relatively large. Furthermore, these systems are also relatively slow, inefficient and comprise precision fitted components which are particularly susceptible to wear.

The printing of reagent fluids is frequently required in the manufacture of chemical assay test strips. Selected reagents are printed in a desired configuration on strips of filter paper. The strips may then be used as a disposable diagnostic tool to determine the presence or absence of a variety of chemical components.

Generally, to perform a chemical assay with a test strip, the strip is exposed to a fluid or a series of fluids to be tested, such as blood, serum or urine. In some instances, the strip is rinsed and processed with additional reagents prior to being interpreted. The precise interpretation depends on the type of chemical reactions involved, but it may be as simple as visually inspecting the test strip for a particular color change.

The manufacture of test strips generally involves either a manufacturing process or a blotting process. The blotting process is the simplest manufacturing method and permits most reagents to be applied without modification. A disadvantage of this process is that it is difficult to blot the fluids onto the test strip with precision.

The printing process will often involve any of three well known methods: silk screening; gravure; and transfer printing. The silk screening of reagents generally involves producing a screen by photographic methods in the desired configuration for each reagent to be printed. The screen is exposed under light to a preselected pattern and then developed. The areas of the screen which are not exposed to light, when devel oped, become porous. However, the areas of the screen which have been exposed to light remain relatively nonporous. The screen is then secured in a frame and the test strip placed below. The desired

reagent fluid, specially prepared to have a high viscosity, is spread over the top side of the screen. The reagent passes through the porous areas of the screen and onto the test strip. The test strip is then subjected to a drying process, specific to each reagent. Once the test strip is dry, it may be printed again using a different screen, pattern and reagent.

5 The gravure method of printing reagents comprises coating a metal surface with a light sensitive polymer. The polymer is exposed to light in the desired predetermined pattern. When developed, the polymer creates hydrophilic and hydrophobic regions. The reagent is specially prepared such that when applied to the metal it will adhere only to the hydrophilic regions. After the specially prepared reagent is applied, the test strip is pressed against the metal and the reagent is transferred from the metal to the test strip.

10 The transfer printing method comprises transferring the reagents from a die to the test strip in the desired pattern. The die is made with the appropriate pattern on its surface and then coated with the desired, specially prepared reagent. A rubber stamp mechanism is pressed against the die to transfer the reagent in the desired pattern from the die to the rubber stamp. The rubber stamp is then pressed against the test strip to transfer the reagent, in the same pattern, to the test strip.

15 Each of the above-mentioned reagent printing techniques has significant disadvantages. The most common disadvantage is the requirement that the reagents must be specially prepared. Additionally, if a variety of reagents are to be printed onto a single test strip, the strip must be carefully aligned prior to each printing. This alignment procedure increases the cost and decreases the throughput of the printing process. Moreover, a special die or screen must be produced for each pattern to be printed. A further disadvantage arises in that the above printing methods are unable to place reproducible minute quantities of reagent on the test strip.

20 It is an object of the present invention to provide a printing and dispensing method and apparatus which avoids these disadvantages.

25

SUMMARY OF THE PRESENT INVENTION

30 The present invention is directed to a reagent dispensing and printing apparatus and method, wherein the apparatus comprises a transducer operative to eject a substantially uniform quantity of reagent in a precise predetermined direction.

35 According to one preferred embodiment of the present invention used in dispensing reagent fluids, a jetting tube is concentrically located with a piezoelectric transducer. The jetting tube comprises an orifice at one end and a reagent receiving aperture at the other end. The receiving end of the jetting tube is connected to a filter which is in turn connected to a reservoir containing a selected reagent. A jetting control unit supplies an electrical pulse of short duration to the transducer in response to a command issued by a computer. The electrical pulse causes the volume defined by the jetting tube to expand by an amount sufficient to intake a small quantity of reagent fluid from the reservoir. At the end of the pulse duration, the transducer de-expands propelling a small quantity of the reagent fluid through the orifice and into a fluid receptacle. If desired, additional droplets may be deposited in the receptacle or the receptacle aligned with an additional jetting tube for receiving an additional reagent fluid.

40 An additional preferred embodiment of the present invention may be used for printing reagent fluids onto a print medium. In this embodiment, the jetting tube is aligned with the printing medium such that the propelled droplet impacts a precise position on the medium. The jetting tube or print medium may then be repositioned and another droplet expelled from the jetting tube. The process may be repeated until a desired configuration of the reagent fluid is printed on the medium.

45 One advantage of the present invention is that precise minute quantities of reagent fluid may be dispensed or printed in a reproducible manner. Additionally, the method and apparatus may be used to emit droplets of fluids having a wide range of reagent fluid viscosities and surface tensions. The reagents do not in general have to be specially adapted for use with the present invention.

50 The invention itself, together with further objects and attendant advantages, will best be understood by reference to the following detailed description, taken in conjunction with the accompanying drawings.

55

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a schematic representation of a first preferred embodiment of the present invention showing the use of multiple jetting heads to meter and dispense reagent fluid.

5 FIGURE 2a is a perspective view of a first preferred embodiment of the jetting head of the present invention.

FIGURE 2b is a cut-away perspective view of the preferred embodiment of Fig. 2a taken along lines 2b-2b with the contact pins removed.

10 FIGURE 2c is a sectional representation of the preferred embodiment of Fig. 2a taken along lines 2c-2c.

FIGURE 2d is a sectional representation of the preferred embodiment of Fig. 2c taken along lines 2d-2d.

FIGURE 2e is a sectional representation of the jetting tube and transducer of the preferred embodiment of Fig. 2b taken along lines 2e-2e.

15 FIGURE 3 is a schematic representation of a second preferred embodiment operating in the drop on demand mode as a reagent printing system.

FIGURE 4 is a schematic representation of a third preferred embodiment operating in the continuous mode as a reagent printing system.

20 FIGURE 5a is a schematic representation of a portion of the jetting head control unit showing the LED strobe circuit.

FIGURE 5b is a schematic representation of a portion of the jetting head control unit showing the high voltage power supply circuit.

FIGURE 5c is a schematic representation of a portion of the jetting head control unit showing the print control circuit.

25 FIGURE 5d is a schematic representation of a portion of the jetting head control unit showing a portion of the print pulse generator.

FIGURE 5e is a schematic representation of a portion of the jetting head control unit showing an additional portion of the pulse generator.

30 FIGURE 6a is a perspective view of a second preferred embodiment of the jetting head of the present invention.

FIGURE 6b is an exploded view of the preferred embodiment of Fig. 6a.

FIGURE 7 is a sectional representation of a third preferred embodiment of the jetting head of the present invention.

35 FIGURE 8 is a sectional view of a symmetrical portion of a fourth preferred embodiment of the jetting head of the present invention.

FIGURE 9 is a graph of the drop mass of the emitted droplets as a function of emission frequency for several fluid viscosities.

FIGURE 10 is a graph of the velocity of the emitted droplets as a function of frequency for several fluid viscosities.

40 FIGURE 11 is a graph of the total weight of fluid emitted as a function of the number of emitted droplets for a given fluid.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

45 Turning now to the drawings, Fig. 1 shows a schematic representation of a first preferred embodiment of a reagent dispensing system generally represented as reference numeral 30. The dispensing system 30 comprises a plurality of reagent fluid reservoirs 200, a plurality of filters 300, a plurality of reagent jetting heads 400, a plurality of jetting head control units 500, an interface unit 600, a computer 700, transportation unit 902, a plurality of fluid mixing cells 904 and a detection station 906.

50 The reservoir 200 holds a selected quantity of reagent fluid for dispensing. The reservoir 200 is maintained at atmospheric pressure by suitable means such as an atmospheric vent. The reagent fluid is transferred from the reservoir 200 through the filter 300 to the reagent jetting head 400. The filter 300 is placed between the reservoir 200 and the jetting head 400 to ensure that any particular foreign matter in the reagent fluid is trapped before entering the jetting head 400.

55 The plurality of jetting heads 400 and the detection station 906 define a processing path. Each jetting head 400, which is described in detail below, ejects uniformly sized droplets 2 of reagent fluid. The droplets 2 are propelled, with controlled velocity and direction, towards a selecting mixing cell 904 positioned along

the processing path by the transportation unit 902. The mixing cells 904 are comprised of non-reactive material and function as minute holding tanks for the dispensed reagent fluid.

The plurality of jetting heads 400, shown in Fig. 1, are positioned sequentially along the processing path. Alternately, some or all of the plurality of jetting heads 400 may be positioned with respect to the transportation unit 902 such that the heads 400 direct the droplets 2 into a selected mixing cell 902 simultaneously.

The jetting heads 400 and the transportation unit 902 are controlled by the computer 700. The computer 700 issues commands to an interface unit 600 which is electrically connected to the transportation unit 902 and to the jetting head control unit 500. The interface unit 600 is of conventional design and is used to control the transfer of information between the computer 700 and the jetting control unit 500. The interface unit 600 is also used to control the transfer of information between the computer 700 and the transportation unit 902.

A first embodiment of the reagent jetting head is shown in Figs. 2a - 2e and generally represented by numeral 400. The jetting head 400 comprises a two piece symmetrical housing 402, 404. The housing 402, 404, when assembled, is adapted to form an orifice aperture 406, an air vent and reagent supply channel 410 and a transducer chamber 403, shown in Fig. 4b. Four screws 408, adapted to respective housing screw apertures 416, hold the housing 402, 404 in an assembled configuration.

The jetting head 400 further comprises a jetting tube 432, a piezo-electric transducer 434 and a reagent fluid supply tube 430. The jetting tube 432 defines a tapered orifice 433 at one end and a fluid receiving aperture 431 at the other end for expelling and receiving fluid, respectively. The piezo-electric transducer 434 is cylindrically shaped and secured concentrically about the mid-region of the jetting tube 432 with epoxy or other suitable means.

The piezo-electric transducer 434, shown in Fig. 2e, defines a first and second end and comprises a section of cylindrically shaped piezo-electric material 435. An inner nickel electrode 437 covers the inner surface of the cylinder 435. The electrode 437 wraps around the first end of the cylinder 435 a sufficient distance to enable electrical connection external to the cylinder 435.

A second nickel electrode 436 covers the majority of the outer surface of the cylinder 435. The second electrode is electrically isolated from the first electrode 437 by an air gap at the face of the second end of the cylinder 435 and by an air gap on the outer surface of the cylinder 435 near the first end. When an electrical pulse is applied to the first and second electrodes 437, 436 a voltage potential is developed radially across the transducer material 435. The voltage potential causes the radial dimensions of the transducer 435 to change, which causes the volume defined by the transducer 434 to also change.

The jetting tube 432 is positioned in the transducer chamber 403 such that the receiving end 431 extends beyond the rearward end of the transducer 434. The receiving end 431 of the jetting tube 432 is inserted into one end of a reagent supply tube 430. The supply tube 430 is sealingly held to the jetting tube 432 by concentric teeth 412 formed by the housing sections 402, 404. The teeth 412 not only seal the supply tube 430 to the jetting tube 432, but, also, seal the supply tube 430 to the housing 402, 404.

The second end of the supply tube 430 passes through the channel 410 and into a reagent reservoir 200. The reservoir 200 contains the reagent fluid to be dispensed by the jetting head 400. As the reagent fluid is dispensed, air is supplied to the reservoir 200 through the channel 410 to prevent the creation of a vacuum in the reservoir 200. The reservoir 200 is releasably attached to the housing 402, 404 and held in place by frictional forces. A reservoir cap 202 is flexibly attached to the reservoir 200 and adapted such that the cap 202 may be used to secure the opening in the reservoir 200 when the reservoir 200 is disengaged from the housing 402, 404.

The position of the jetting tube 432 defines the horizontal plane of the jetting head 400. The jetting tube 432 and the transducer 434 are held in a pre-defined vertical relationship with respect to the housing 402, 404 by means of two upper vertical alignment pins 418 and two lower vertical alignment pins 418. The two upper vertical alignment pins 418 extend horizontally from the housing section 402 into the transducer chamber 403. Similarly, the two lower vertical alignment pins 418 extend horizontally from the housing section 404 into the transducer chamber 403. Each vertical alignment pin 418 is formed integrally with the respective housing sections 402, 404.

The jetting tube 432 and the transducer 434 are held in a predefined horizontal relationship with respect to the housing 402, 404 by means of four horizontal alignment pins 424. Two of the horizontal alignment pins 424 extend horizontally from the housing section 402 approximately midway into the transducer chamber 403. Similarly, two of the horizontal alignment pins 424 extend horizontally from the housing section 404 approximately midway into the transducing chamber 403. Each horizontal alignment pin 424 is formed integrally with the respective housing section 402, 404. The alignment pins 418, 424, sealing teeth 412 and orifice aperture 406 are aligned and adapted to hold the jetting tube 432 and transducer 434 such

that the orifice 433 of the jetting tube 432 extends into the orifice aperture 406.

An electrical transducer activation pulse is supplied to the piezo-electric transducer 434 from the jetting head control unit 500 by means of two contact pins 422. A quantity of fluid will be dispensed from the jetting tube for each applied activation pulse. The activation pulse can be produced by a variety of conventional circuits or commercially available units. Therefore a detailed description of such a circuit will not be provided. However, a circuit for producing a series of activation pulses is provided in the description of the printing embodiment below. Due to the differing constraints involved in dispensing and printing, the circuit in the printing embodiment is not required to produce only a single pulse. However, one skilled in the art could, if desired, modify the circuit to produce a single pulse on demand for use in the dispensing embodiment.

Each contact pin 422 defines an enlarged head 423 which is adapted to contact the respective first and second electrodes 437, 436 located on the outer surface of the transducer 434. Two contact pin holders 414, integral with the housing 402, 404, are positioned to hold the respective contact pins 422 under the pin heads 423 such that each pin head 423 electrically engages the appropriate electrode 437, 436 of the transducer 434. Two contact pin engaging posts 420 extend from the housing 402, 404 opposite the contact pin holders 414 to engage and hold the contact pins 422 against the contact pin holders 414. The ends of the contact pins 422 opposite the pin heads 423 extend through the housing 402, 404 by means of contact pin apertures 421. Since the housing sections 402, 404 are formed symmetrically to one another, the contact pins 422 may be optionally attached above the transducer 434.

In operation, the reservoir 200 containing reagent fluid is fastened to the jetting head 400 such that the fluid supply tube 430 extends into the reagent fluid. The filter 300 may be fitted to the free end of the supply tube 430 or positioned inside the reservoir 200. Air is supplied through the channel 410 around the supply tube 430 to prevent the reservoir 200 from falling below atmospheric pressure. The air is prevented from entering around the supply tube 430 and into the transducer chamber 403 by the seal created between the sealing teeth 412 and the supply tube 430. The jetting tube 432 may be primed by slightly pressurizing the reservoir 200 to cause the reagent fluid to travel through the supply tube 430 and into the jetting tube 432. Once primed, the fluid is prevented from substantially withdrawing from the jetting tube 432 by the surface tension of the reagent fluid at the orifice 433.

The transducer activation pulse is conducted to the contact pins 422 of the jetting head 400. The contact pins 422 communicate the high voltage pulse to the electrodes 437, 436 of the transducer 434 with polarity such that the concentrically mounted transducer 434 expands. The rate of expansion is controlled by the rise time of the high voltage pulse which is preset to generate a rapid expansion. The expansion of the transducer 434 causes the jetting tube 432, which is epoxied to the transducer 434, to also expand. The expansion of the tube 432 generates an acoustic expansion wave interior to the tube 432 which travels axially towards the orifice 433 and towards the fluid receiving aperture 431. When the expansion wave reaches the orifice 433, the reagent fluid is partially drawn inwardly. However, the surface tension of the fluid acts to inhibit substantial inward fluid movement.

When the expansion wave reaches the end 431 of the tube 432, the expansion wave is reflected and becomes a compression wave which travels towards the center of the piezo-electric tube 434. The high voltage pulse width is adapted such that when the reflected compression wave is beneath the piezo-electric tube 434, the high voltage pulse falls, resulting in a de-expansion of the transducer 434 and the jetting tube 432. This action adds to the existing acoustic compression wave in the interior of the jetting tube 432. The enhanced compression wave travels toward the orifice causing reagent fluid to be dispensed from the tube 432. The fluid is propelled from the orifice 433 as a small droplet 2 and deposited in the selected mixing cell 904 positioned by the transportation unit 902. One droplet 2 is dispensed for each transducer activation pulse. This mode of dispensing is referred to as the drop on demand mode.

In some instances, the droplet 2 may be accompanied by at least one smaller satellite droplet. However, even if satellite droplets are present, the volume and velocity of the reagent droplets 2 are highly reproduceable. This reproduceability allows for precise dispensing of uniform, controllably sized droplets 2 of reagent fluid into the mixing cell 904.

The droplets 2 of reagents impact the mixing cell 904 with sufficient force and volume to cause fluidic mixing of the reagents. Once the desired amounts of the selected reagents are deposited in the selected mixing cell 904, mixing cell 904 is transported to the detection station 906 where the mixed reagents may be extracted for use or analyzed for assay results.

The dispensing system 30 provides numerous advantages based upon the ability of the reagent jetting head 400 to rapidly and reproduceably eject uniform quantities of a wide range of reagents. The reaction times of some chemical processes are dependent upon the volume of the reagents used. The ability of the dispensing system 30 to dispense such minute amounts of reagents thereby reduces the processing time

of certain chemical assays. Furthermore, some chemical assays require a wide range of dilution ratios. Many conventional dispensing systems are unable to dispense the reagents in volume small enough to make the desired assay practical. The dispensing system of the present invention overcomes this disadvantage.

5 In addition to dispensing reagent fluids, certain embodiments may be used for precision printing of reagents onto a printing medium such as filter paper to produce an assay test strip. A printing system 10 using the present invention is represented in Fig. 3. Structure similar in form and function to structure described above will be designated by like reference numerals. The printing system 10 comprises a reagent fluid reservoir 200, a filter 300, a reagent jetting head 400, a jetting head control unit 500, an
10 interface 600, a computer 700, and an x-y plotter 800.

The x-y plotter 800 is a commercially available pen plotter, mechanically modified in a conventional manner such that the pen is replaced with the jetting head 400. The general operation and structure of the plotter 800 will not be described in detail. The plotter 800 accepts commands from the computer 700 thru a standard RS-232 serial interface contained within the interface unit 600. The plotter 800 processes the
15 commands and produces control signals to drive an x-axis motor (not shown) and a y-axis motor (not shown). The x-axis motor is used to position the jetting head 400 and the y-axis motor is used to position a drum (not shown) to which the printing target 1 is attached.

The plotter 800 produces a pen down signal PENDN. This signal is applied to the control unit 500 and indicates that the plotter 800 is ready to begin a printing operation.

20 The control unit 500 also receives control signals from the interface unit 600. These signals include signals HIGHER*, LOWER* to control the magnitude of the pulse applied to the transducer 434; a reset signal RST to reset the control unit 500; and a series of print signals PRT*. The generation of these signals will not be described in detail since their production is performed by the conventional interface unit 600.

The jetting head 400 and fluid supply system 200, 300 are initialized and operate substantially as
25 described above. The jetting head control unit 500, shown in Figs. 5a - 5e comprises a print control circuit 510, a pulse generator 530, a high voltage supply 540, and a strobe pulse generator 560. The control unit 500 also comprises a power supply. However, since the power supply is of conventional design it will not be shown or described in detail.

The print control circuit 510 receives the pen down signal PENDN from the plotter 800 and comprises a
30 transistor Q100, a one-shot circuit U100, two NAND-gates U101, U102, a line decoder multiplexer U107 and four inverters U103-U106. The pen down signal PENDN is applied to the base of the transistor Q100 by resistors R100, R101 and diode D100. The emitter of transistor Q100 is tied to ground and the collector is connected to the +5 volt supply by resistor R102.

The one-shot U100 comprises inputs A, B and an output Q. The B input of the one-shot U100 is
35 connected to the collector of the transistor Q100 and the A input is tied to ground. The time period of the pulse produced by the one-shot U100 is determined by a resistor R104, a variable resistor R105 and a capacitor C100. The output Q of the one-shot U100 is combined with the collector output of the transistor Q100 by the NAND-gate U101 and then inverted by the NAND-gate U102. The circuit is operative to produce an adjustable delay in the application of the pen down signal PENDN to the control unit 500.

40 The line decoder U107 is circuited to function as a 3 input AND-gate. The output of the NAND-gate U102 is applied to the first input of the decoder U107; the print signal line PRT* comprising a series of pulses from the interface unit 600 is applied to the second input; and a jetting head ON/OFF signal from switch S1 is applied to the third input. The inverter U106 inverts the output of the line decoder U107 to generate the print control signal PRT* and the inverters U103-U105 invert the control signals LOWER*,
45 HIGHER*, and RST signals, respectively.

The high voltage supply 540, shown in Fig. 5b, provides +175 volts DC to produce a maximum pulse of +150 volts peak to peak at the reagent jetting head 400. The high voltage supply 540 comprises differential amplifier U12 and transistors Q1, Q2, Q13, Q14. A stable reference voltage of -2.5 volts DC is produced at the junction of a resistor R13, connected to the -15 volt supply, and a diode CR6, connected
50 to ground. The reference voltage is combined with a resistor R14 to produce an adjustable, stable voltage reference for the amplifier U12. The reference voltage is applied to the inverting input of the amplifier U12 through a resistor R11. The noninverting input of the amplifier U12 is connected to ground by a resistor R12. The amplifier U12, in combination with a feedback resistor R10, produces an output signal proportional to the difference of the voltage reference signal and the ground potential.

55 The output of the amplifier U12 is applied to the base of the transistor Q2 whose collector is connected to the +15 volt supply. The signal produced at the emitter of the transistor Q2 is applied to the base of the transistor Q1 through resistors R8, R6, R5, a transformer L1 and diodes CR4, CR2, CR1. The emitter of the transistor Q1 is connected to ground and the collector is connected to the +15 voltage supply through the

transformer L1. A diode CR3 connects the collector of the transistor Q1 to the junction of the resistor R5 and the diode CR4. The transistor Q1 is biased for proper operation by resistors R7, R6, R5. The resistor R7 and a capacitor C22 connect the junction of the resistor R8, R6 to the +15 voltage supply.

The transistor Q1 and the transformer L1 form a "flyback" blocking oscillator. Any increase in current supplied by the transistor Q1 produces an increase in energy transferred through the secondary winding of the transformer L1 and diode CR5. Therefore, an increase in current supplied by the transistor Q1 results in an increase in power available to the high voltage output. The diodes CR1-CR4 form a "Baker clamp" which prevents transistor Q1 from saturating. The clamp thereby avoids transistor storage time.

The diode CR5 is connected to a multiple pi filter formed by the inductors L3, L2, capacitors C24, C21, C41 and resistors R29. The multiple pi filter attenuates ripple and switching spikes in the signal supplied to the transistor Q13 which produces the high voltage output V_{++} . A resistor R64 connects the base of the transistor Q13 to the emitter and to the resistor U29. The base is also connected to the collector of the transistor Q14 by a resistor R65. The base of the transistor Q14 is connected to the +15 volt supply by a resistor R67 and to ground by a resistor R66. The emitter of the transistor Q13 provides a signal HV SENSE which is fed back to the inverting input of the amplifier U12 through a resistor R9. The high voltage output V_{++} is produced at the collector of the transistor Q13. The proper biasing of the transistor Q13 is provided by resistor R64 and the biasing circuit comprising the transistor Q14, resistors R67, R66, R65.

The pulse generator 530, shown in Figs. 5d, 5e, comprises an opto-isolator U18, a one-shot U23, a digital to analog (D/A) converter U30 and two binary counters U24, U25. The pulse generator 530 accepts control signals PRT*, LOWER*, HIGHER*, RST and produces the activation pulse which is applied to the transducer 434. In normal operation, the PRT* control signal is supplied to the opto-isolator U18 by a jumper JMP between contact points E5, E6. The opto-isolator U18 is of conventional design and comprises a light emitting diode (LED) circuit and a photo-element circuit. A resistor R15 operates as the load resistor for the LED circuit of the isolator and a capacitor C25 suppresses transient noise on the voltage supply to the isolator U18. The output of the isolator U18 is applied to one input of the one-shot U23 whose time constant is adjustably determined by resistors R38, R25 and a capacitor C30. The pulse from the non-inverting output of the one-shot U23 is fed to the base of a transistor Q9. A resistor R39 sets the approximate base current of the transistor Q9 which is used as a level shifter for converting the CMOS signal level to the +15 volt DC signal level.

The control of the rise and fall rates of the pulse generator 530 is accomplished by directing a pair of current source transistors Q11, Q12 to charge and discharge a capacitor C57. The transistor Q11 is operative as a source of current and the transistor Q12 is operative as a sink for current. A transistor Q10 controls the level of the current by applying an appropriate bias current through a resistor R56 to the base of the transistor Q11. The biasing of the transistors Q11, Q12 is critical to the proper rise and fall rates. Therefore precision voltage references CR13, CR15 are used to provide respective bias reference voltages. A temperature compensation network is formed from zener diodes CR14, CR16 and resistors R55, R54 to maintain stable operation of the transistors Q11, Q12, respectively. The variable resistors R49, R52 may be used to adjust the fall time and rise time, respectively, of the output pulse applied to the reagent jetting head 400. A plurality of resistors R45, R46, R47, R48, R49, R51, R52, R53, R56, R57, R58 are used to properly bias the transistor Q10, Q11, Q12 and capacitors C55, C60 are circuited to maintain stability of the circuit.

The impedance of the output stage of the rise and fall circuitry Q10, Q11, Q12 is very high. With such a high impedance, circuit elements attached to the capacitor C57 could affect the linearity of the rise and fall time constants. Therefore, an FET input operational amplifier U32 is used as an impedance interface. The amplifier U32 is configured in the noninverting mode and circuited with capacitors C58, C59 for stability.

The output of the amplifier U32 is applied to an inverting amplifier U31 by means of a resistor R62. The amplifier U31 inverts and conditions the pulse control signal with the aid of resistors R59, R60. Resistors R61, R63, connected to the -15 voltage supply, provide a means for adjusting the DC level offset of the amplifier U31 output signal. Capacitors C51, C52 are connected to enhance the performance and stability of the circuit.

The output of the amplifier U31 is applied by means of a resistor R41 to the positive voltage reference signal input REF(+) of the D/A converter U30. The negative voltage reference signal input REF(-) is tied to ground by a resistor R40. The D/A converter U30 produces output signals IOUT, IOUT* which are proportional to the difference between the positive and negative voltage reference signal inputs REF(+), REF(-). Capacitors C48, C49, C50 are connected to the D/A converter U30 to enhance stability.

The D/A converter outputs IOUT, IOUT* are also proportional to an 8-bit binary value applied to inputs B1-B8. The binary value is supplied by the counters U24, U25 which are controlled by the function signals LOWER*, HIGHER* and RST. The LOWER* signal and the HIGHER* signals are applied to the count up and

count down inputs CU, CD of the counter U24 by means of opto-isolators U19, U20. The carry and borrow outputs CY, BR of the counter U24 are connected with the count up and count down inputs CU, CD of the counter U25. The reset inputs RST of both counters U24, U25 receive the RST signal by means of an opto-isolator U21. Resistors R16, R17, R18 are used as load resistors for the LED circuits of the isolators U19, U20, U21 and capacitors C26, C27, C28 are used to enhance the stability of the isolator circuits.

The counters U24, U25 may optionally be preloaded to the selected 8-bit binary value through input lines TP0-TP7. The input lines TP0-TP7 are normally biased to the logical high signal state by resistive network U22. The selected binary value is loaded into the counters U24, U25 by pulling the respective inputs TP0-TP7 low and applying an external, active low, load signal EXT LOAD to pin TP8. The load signal pin TP8 is connected to the load inputs LOAD of the counters U24, U25 and conditioned by a clipping circuit comprised of diodes CR9, CR10 and a pull-up resistor of the resistor network U22.

The noninverted and the inverted outputs IOUT, IOUT* are connected to the inverting and noninverting inputs of a differential amplifier U29. The output of the amplifier U29 is fed back to the inverting input by a resistor R50. The amplifier U29 converts the current output of the D/A converter U30 to a voltage output. Capacitors C56, C47 are provided to enhance circuit stability.

The output of the amplifier U29 is applied to the noninverting input of the amplifier U28. The output of the amplifier U28 is fed back to the inverting input by means of a capacitor C46 and a resistor R37. The inverting input is also connected to ground by a resistor R36. To enhance the frequency response of the amplifier U28, a resistor R43 and a capacitor C54 are connected between the frequency compensation input FC and ground. An adjustable DC offset is provided by connecting the output offset inputs OF, OF with a variable resistor R42. The wiper of the resistor R42 is connected to the high voltage power supply output V+.

The output of the amplifier U28 is also connected to the base of a transistor Q4 and through diodes CR11, CR12 to the base of a transistor Q7. The transistor Q4, Q7, Q3 and resistors R30-R35 form an output circuit capable of driving high capacitive loads at high slew rates and wide bandwidth. The variable resistor R31 may be used to set the maximum current through the bias network R30, R33 by measuring the voltage drop across resistor R35.

The strobe generator 560 produces a strobe pulse and comprises transistors Q101-Q105 and a one-shot circuit U108. The strobe intensity is determined by the circuit comprising the transistors Q101-Q104 and resistors R109-R115. The circuit is connected to the anode of the LED 900 and receives two inputs from the interface unit 600 to produce four levels of light intensity in the LED 900.

The activation and duration of activation of the LED 900 is determined by the one-shot U108 and the transistor Q105. The one-shot U108 comprises inputs A, B and an output Q. The strobe signal STROBE is applied to the B input from the interface unit 600. The duration of the one-shot U108 output pulse is controlled by the adjustable RC network R107, R108. The output Q is applied to the base of the transistor Q105 by resistor R108. The collector of the transistor Q105 is connected to the cathode of the LED 900 to draw current through the LED 900.

The computer 700, control unit 500 and plotter 800 must be initialized. The initialization of the computer 700 and the plotter 800 will not be discussed since these units are of conventional design and operation.

To initialize the jetting head control unit 500, the computer 700 directs the interface unit 600 to issue a reset command. The reset signal RST is conducted to the control unit 500 whereupon the counters U24, U25 are cleared. The computer 700 then retrieves from its memory, or by conventional operator input, the desired digital setting for the D/A converter. This setting may also be calculated from data and may be tailored to specific sizes of jetting heads 400 or reagent fluids. The computer 700 then issues a series of commands, through the interface unit 600, to increment or decrement the counters U24, U25 to correspond to the desired binary setting. If the command directs that the counters are to be raised, then the HIGHER* signal is applied through the opto-isolator U20 to the count up CU input of the counter U24. Similarly, if the command directs that the counters are to be lowered then the LOWER* signal is applied through the opto-isolator U19 to the count down CD input of the counter U24. Since the carry and borrow outputs CY, BR of the counter U24 are connected to the count up and count down inputs CU, CD, respectively, of the counter U25, the digital setting applied to the D/A converter U30 may range from 0 to 255. Alternately, the counters U24, U25 could be initialized to a desired setting by loading the binary value on the lines TP0-TP7 and strobing the EXT LOAD line.

Once the control unit 500 and the plotter 800 are initialized, the printing cycle may begin. The computer 700 issues a command to the interface unit 600 to produce the series of PRT* signal pulses. The computer 700 then commands the plotter 800 to print, for example, a line along a selected path. The plotter 800 positions the jetting head 400 and target 1 and issues the pen down signal PENDN. The signal is delayed by the print control circuit 510 to ensure that the target 1 is properly positioned. At the expiration of the

delay, the signal is ANDed with the closed enable switch S1 and the series of print pulses PRT*. The result of the AND operation is the application of the PRT* pulses to the pulse generator circuit 530.

The PRT* signal is applied through the jumper JMP to the opto-isolator U18 and then to the one-shot U23. The one-shot U23 produces a pulse signal which is then converted from CMOS signal levels to the 15 volt DC signal level by the transistor Q9. The rise and fall circuitry comprising Q10, Q11, Q12 converts the square wave pulse into a pulse having the rise and fall characteristics preset by the resistors R49, R52. The conditioned pulse is then amplified by the amplifier U32 and applied to the amplifier U31.

The amplifier U31 converts the polarity of the conditioned pulse to that acceptable by the D/A converter U30 and supplies an adjustable DC offset. The DC offset is used to counteract possible distortion attributable to the amplifier U31. The distortion arises in that, for the amplifier U31 to be adequately responsive, a small degree of current must flow through the resistor R41. This current creates an offset condition at the output of the amplifier U29 which is then scaled by the D/A converter U30 in correspondence with the binary data. The resistor R63 allows a small amount of current to be applied to the amplifier U31 to control the offset voltage attributable to the current flowing through the resistor R41.

The D/A converter U30 scales the difference between the inputs REF(+), REF(-) using the binary data supplied to input lines B1-B8 to produce a current output pulse IOUT and a current inverted output pulse IOUT*. The two outputs IOUT, IOUT* are fed to the amplifier U29 which convert the current outputs into a single voltage output. The scaled, conditioned pulse is then applied to the output circuit comprising the amplifier U28 and the transistors Q3, Q4, Q5, Q6, Q7. The circuit produces a high voltage pulse with the aforementioned rise and fall characteristics to drive the piezo-electric transducer 434.

The high voltage pulse is applied to the transducer 434 and causes a droplet 2 of fluid to be propelled onto the target 1. Since the pen down signal PENDN is still applied, additional droplets 2 are produced from the jetting head 400. The plotter 800 moves the jetting head 400 and target 1 along the desired path during the emission of the droplets 2 to produce the desired printed line. When the printing is complete, the plotter 800 removes the pen down signal PENDN and the droplet emission stops. Of course it should be understood that dots, circles and the like could be produced by appropriate positioning of the target 1 and jetting head 400.

The size and uniformity of the droplets 2, as well as the presence of any satellite droplets, may be observed with the aid of the scope 950 and the LED 900. The scope 950 and the LED 900 are positioned such that the droplets 2 pass between the scope 950 and the LED 900 and within the focal range of the scope 950. The strobe pulse when applied to the LED 900 causes the LED 900 to momentarily flash. The timing of the activation and the width of the pulse may be adjusted such that the flash occurs when the fluid, expelled in response to the high voltage pulse, is between the scope 950 and the LED 900. The dispensed quantity of fluid may then be observed in flight or at or near the moment of separation from the orifice 433. Corrections based on the observation may then be made to the system 10.

Since each droplet 2 is small in volume, the droplet 2 may be rapidly absorbed by the target 1, thereby allowing rapid and precise placement of a variety of reagents on the target 1 with reduced drying time and reduced potential of fluidity mixing. In addition, the ability to place small droplets 2 in a precise manner enables the target 1 to be printed in a high density matrix with a variety of reagents as isolated matrix elements.

In some printing applications, particularly when printing fluids of flow viscosity and surface tension, it may be desirable to force the fluid through the jetting tube 432 under pressure and allow the vibrations produced by the transducer 434 to break the emitted fluid stream into precise droplets 2. Under this mode of printing, the emission of droplets 2 can not be stopped by cessation of the transducers activation pulse. It is therefore necessary to prevent fluid emission by other means. One preferred means of momentarily stopping emission of the droplets is shown schematically in Fig. 4. In this arrangement, structure similar to structure represented in Fig. 3 in form and function, is represented by like reference numerals.

The arrangement, generally represented by the numeral 20, includes a closed reagent recirculation system comprising a normally close three way valve 970, a sump 960 and a recirculation pump 980. In the continuous mode, the reagent fluid is forced out the orifice 433 by hydraulic pressure and broken into a series of substantially uniform droplets 2 by movement of the transducer 434. A regulated, filtered air supply 100 is used to pressurize the reagent fluid reservoir 200. The reagent fluid within the reservoir 200 may optionally be agitated by a magnetic stirrer unit 990. This is especially useful for reagent fluids comprising suspended particles.

The three-way valve 970 comprises a common channel, a normally open channel and a normally closed channel. The fluid is forced through the filter 300 and applied to the normally closed channel of the valve 970. When the normally closed channel is closed, the normally open channel of the valve 970 functions as a vent for the reagent jetting head 400. The common channel is connected to the reagent supply tube 430

of the jetting head 400. The reagent supply tube 430 is also connected to the sump 960.

In operation, the normally closed channel is opened by an appropriate signal supplied by the computer 700 which also closes the normally open channel. When the normally closed channel is opened, fluid is permitted to pass to the sump 960 and to the jetting head 400. The sump 960 collects the reagent fluid not transferred to the jetting head 400. The sump 960 supplies the collected fluid to the inlet side of the recirculating pump 980 which returns the fluid to the reservoir 200. The returned fluid is then mixed with the contents of the reservoir 200 and is available for recirculation.

When operating in the continuous mode, rather than interrupt the continuous stream of print pulses to the jetting head 400, the printing may be momentarily stopped by closing the normally closed channel of the valve 970. The closing of the normally closed channel stops the flow of reagent fluid to the jetting head 400 and allows the jetting head 400 to vent to atmospheric pressure. With the fluid supply blocked, the transducer 434 is unable to expel further droplets 2. Thus, if positioning of the target 1 by the plotter 800 requires a longer time interval than the time between droplet 2 emission, the computer 700 may close the normally closed channel of the valve 970. The plotter 800 may then position the target 1 or position a new target 1 as desired.

When printing, the active ingredient of the reagent is tailored to achieve a desired concentration per unit area on the target 1. However, to a certain extent the final concentration per unit area can be adjusted by varying the density of the droplets 2 printed on the target 1. The preferred embodiment is particularly well suited to this application due to its ability to print precise, discrete pels of reagent.

A second preferred embodiment of the jetting head is illustrated in Figs. 6a-6b and is generally represented as 400'. The jetting head 400' comprises housing formed into three sections 401', 402', 403'. The housing section 403' comprises a recessed region which forms the reagent fluid reservoir 200' when the housing section 403' is positioned against housing section 402'.

The jetting head 400' further comprises a piezo-electric transducer 434' and a reagent jetting tube 432' similar to those of the first embodiment. The jetting head 400' and the transducer 434' are most clearly shown in Fig. 6b. The jetting tube 432' defines an orifice 433' at one end and a reagent fluid receiving aperture 431' at the other end. The transducer 434' is mounted to the jetting tube 432' concentrically about the mid-region of the tube 432' with epoxy.

The transducer 434' and the jetting tube 432' are positioned in channels 420', 418', 416' located in the housing sections 402', 401'. The channel 416' comprises a plurality of sealing teeth 412' operative to engage and seal against the fluid receiving end 431' of the jetting tube 432'. The channel 416' is connected to the reagent fluid supply channel 430'. The supply channel 430' is connected with the fluid reservoir 200' by means of an aperture 431' through the housing section 402', shown in Fig. 6b.

The reservoir 200' comprises a flexible reservoir lining 201' adapted to contain the reagent fluid. The lining 201' comprises one aperture which is connected to the housing 402' to allow the fluid to pass from the lining 201'. A vent (not shown), located in the housing 403', allows the space between the reservoir 200' and the lining 201' to be vented or pressurized. A filter 300' is positioned within the aperture 202' to trap unwanted particulate foreign matter.

Electrical pulses are supplied to the transducer 434' by means of two contact pins 422'. The pins 422' are inserted through respective apertures 419' of the housing section 402' and respective apertures 421' of the housing section 403'. Two thin electrically conductive strips 410', 411', shown in Fig. 6b, are used to connect the transducer 434' with the contact pins 422'. A protective shield 405' extends from the housing position 403' to partially isolate the protruding portions of the contact pins 422'.

The function and operation of the jetting head 400' is similar to that of the jetting head 400 and therefore will not be discussed in detail. The collapsible inner lining 201' of the reservoir 200 allows the jetting tube 432' to be primed by pressurizing the reservoir 200' through the vent 205'. Once primed, the jetting head 400' may be used as described above in reference to the jetting head 400.

The jetting head 400' provides an advantage in that the entire fluidic system is contained in one housing. Such containment allows for fast and efficient replacement of the jetting heads without fluid contamination problems.

A third preferred embodiment of the jetting head is shown in Fig. 7 and generally represented as 400". The jetting head 400" comprises a housing 403", a reagent fluid supply tube 406", a piezo-electric transducer 434" and an orifice plate 404". The housing 403" defines a conically shaped fluid chamber 432". An orifice plate 404", defining an orifice 433", is fastened to the housing 403" such that the orifice 433" is located at or near the apex of the conical fluid chamber 432".

The fluid feed tube 406" is attached to the housing 403" and defines a supply channel 430". The supply channel 430" is in fluid communication with the fluid chamber 432" by means of a connecting channel 431". The base of the fluid chamber 432" is formed by the disc-shaped transducer 434". The transducer 434" is

held in position by a hold down plate 402" attached to the housing 403". The electrical connections to the transducer 434" are of conventional design and are therefore not shown. The housing 403" further comprises a threaded aperture 406" for mounting the jetting head 400".

The jetting head 400" operates in a manner similar to the jetting heads described above. However, in this jetting head the transducer 434" is normally disk shaped. When the electrical pulse is applied, the transducer 434" bends slightly, thereby altering the volume of the conically shaped jetting chamber 432". The change in volume of the chamber 432" causes the expulsion of fluid through the orifice 433" and the intake of fluid through the supply channel 430" as described in reference to the jetting head 400.

A fourth preferred embodiment of the jetting head is shown in Fig. 8 and is generally represented as 400". The jetting head 400" is very similar in form and function to the jetting head 400 and will not be described in detail. The jetting head 400" comprises two symmetrical housing sections. The sections may be connected together by means of apertures 409" and screws, not shown. When assembled, the housing sections 404", 402" form a T-shaped supply channel 410".

In operation, the jetting head 400" functions in a manner similar to the jetting head 400. The jetting head 400" is especially suited for use in the continuous mode, but may also be used in the drop on demand mode. In the continuous mode, the fluid is circulated continuously through the supply channel 430" allowing the jetting tube 432" to withdraw as much fluid as required.

By way of illustrating and with no limitations intended the following information is given to further illustrate the above described embodiments. The computer 700 is an IBM Corporation Personal Computer with 640 kbytes of RAM memory. The interface unit 600 is a Burr Brown interface unit model number PC 20001. The plotter 800 is manufactured by Houston Instrument as model number DMP-40. Communication between the plotter 800 and the interface unit 600 is performed through a standard asynchronous serial communication port.

The electrical pulse applied to the jetting head 400 to activate the transducer 434 comprises a rise time of approximately 5 usecs, a fall time of approximately 5 usecs and a pulse width of approximately 35 usecs. When the transducer 434 is operated in the drop on demand mode, the voltage potential of the pulse is 60 volts plus or minus 10 volts and the pulse frequency can be up to 4 khz. When the transducer 434 is operated in the continuous mode, the voltage potential of the pulse is 30 volts plus or minus 10 volts and the pulse frequency can be up to 10 khz.

The jetting tube 432 is manufactured from a pyrex glass tube and measures .027 inches outside diameter and .020 inches inside diameter. The tube is drawn to a closed taper in an electric furnace. The tapered end is then cut and ground to a desired orifice opening of .002 to .004 inches in diameter. The tube is cut to a final length of .945 inches in the case of the dispenser embodiment and ultrasonically cleaned in acetone. After being cleaned and dried the large end of the tube is fire polished. If desired, the orifice end of the tube may receive a coating, such as a hydrophobic polymer, to enhance droplet separation from the tube.

The supply tube 430 is formed from .023 inch inside diameter and .38 inch outside diameter polyethylene tubing produced by Intramedic Corp. as model number #14 170 11B. During assembly, one end of the tubing is stretched over a warm tapered mandrel. The stretched end of the supply tube 430 is then inserted over the large fire polished end of the jetting tube 432. The assembly is then cleaned and baked in a circulating air oven at 50°C. for 10 minutes.

The transducer 434 was purchased from Vernitron of Cleveland, Ohio as model number PZT-5H. The electrodes 437, 436 are comprised of nickel and are separated from each other on the outer surface of the transducer by approximately .030 inches. The jetting tube 432 is inserted into the cylindrical piezo-electric tube 434 and secured with epoxy manufactured by Epoxy Technology of Bellerica, Massachusetts as model number 301. The epoxy is applied at the junction of the tube 432 and transducer 434 with a syringe. The epoxy flows along the tube 432 inside the transducer 434 by capillary action. The assembly is then baked in a circulating air oven at 65°C. for one hour to cure the epoxy.

The contact pins 422 are secured to one of the housing sections 402, 404 with a drop of epoxy. The transducer jetting tube 434, 432 is placed in the housing such that the orifice end 433 of the tube 432 protrudes approximately .030 inches from the housing 403, 404. A drop of silver epoxy is placed between each contact pin 422 and the transducer 434 to ensure a secure electrical connection. Epoxy is also applied to the junction of the housing 402, 404 and supply tube 430. The other section of the housing 402, 404 is then screwed into place.

The periphery of the housing 402, 404 is sealed with a capillary sealer such as cyclohexanone. Epoxy is then added around each contact pin 422 and around the orifice end 433. The assembly is then baked in a circulating air oven at 65°C. for one hour.

The filter 300 is formed from a polyester mesh with 30 um pores and positioned in a polypropylene

housing. The air pressure supplied to the reservoir 200 during continuous printing operations is regulated at approximately 10 to 30 psi.

The reagents used have the following characteristics:

Printing (drop on demand mode):

5 Fluid viscosity range: 1 - 30 centipoises

Fluid surface tension: 20 - 70 dyne/cm

Printing (continuous mode):

Fluid viscosity range: up to 50 centipoises

Fluid surface tension: not measured

10 Dispensing (drop on demand mode):

Fluid viscosity range: 2 - 30 centipoises

Fluid surface tension: 20 - 70 dyne/cm

A measure of the performance and selected operating characteristics for a typical jetting head are presented in Figs. 9-11. Fig. 9 is a graph of the mass of a droplet as a function of droplet emission
15 frequency for three fluids. The viscosity of the fluids were 1, 5 and 24 centipoise and the transducer excitation pulse width was 35 microseconds. As shown in Fig. 9, the higher fluid viscosity results in a more stable operating performance of the jetting head. Fig. 10 is a graph of droplet velocity as a function of droplet emission frequency for fluid viscosities of 1, 5 and 24 centipoise. The log of the total fluid weight as a function of the log of the number of droplets emitted is shown in Fig. 11. The fluid used has a viscosity of
20 2 centipoise, a surface tension of 20 dynes/cm, and a density of .8 grams/cc. The transducer excitation pulse was 80 volts and the excitation frequency was approximately 711 Hz.

Some blood typing reagents and some allergen reagents have very low viscosities and surface tensions. Although in some cases viscosity modifiers, such as glycerol, dextran, glucose, and the like, may be added to increase the viscosity, a few reagents are adversely affected by such modifiers.

25 Developing stable and reproduceable demand mode jetting is difficult with very low viscosities. Although droplet emission can be established at some fundamental frequencies, the droplets dispensed may have small satellite droplets which reduce the accuracy for metering and dispensing applications. However, even with the satellite drops, sufficient reagent is adequately delivered for most print applications without a substantial decrease in print quality.

30 Glycerin may be used as a viscosity modifier to improve jetting reliability and to prevent obstruction of the orifice arising from evaporation of the reagent fluid components. Glycerin has been found especially beneficial for those reagents containing particulate material. The evaporation of the fluid component results in a concentration of glycerin located at the orifice. The plug of glycerin substantially prevents further evaporation of the reagent fluid. During the next activation cycle of the transducer, the plug of glycerin is
35 expelled from the orifice.

When operating in the dispensing mode the volume of the droplets can be varied to substantially uniformly contain from 100 pico-liters to 1 micro-liter. The droplets can be produced at a rate of approximately 1 khz to 8 khz. When operating in the printing mode the size of the pel made by each droplet measures approximately .001-.012 inches in diameter.

40 A copy of the program used in the computer 700 for a printing operation is attached hereto as Appendix A. The values, manufacturer and manufacturing part number of the circuit components of the jetting control unit 500 are substantially as follows:

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Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
10 R39, 45-48, 57, 58	RES. 10KOHM $\frac{1}{2}$ WATT5%C.F.	
R66	RES. 150OHM $\frac{1}{2}$ WATT5%C.F.	
R3	RES. 15KOHM $\frac{1}{2}$ WATT5%C.F.	
15 R34	RES. 16KOHM $\frac{1}{2}$ WATT5%C.F.	
R50	RES. 2.4KOHM $\frac{1}{2}$ WATT1%M.F.	DALE RLO79242G
R13, 23, 36, 40, 41	RES. 2.4KOHM $\frac{1}{2}$ WATT5%C.F.	
R56	RES. 20KOHM $\frac{1}{2}$ WATT5%C.F.	
20 R8	RES. 220OHM $\frac{1}{2}$ WATT5%C.F.	
R6	RES. 27OHM $\frac{1}{2}$ WATT5%C.C.	
R7, 12, 25	RES. 2KOHM $\frac{1}{2}$ WATT5%C.F.	
R67	RES. 3.6KOHM $\frac{1}{2}$ WATT5%C.F.	
25 R51, 53	RES. 3.9KOHM $\frac{1}{2}$ WATT5%C.F.	
R29	RES. 300KOHM $\frac{1}{2}$ WATT5%C.F.	
R61	RES. 30KOHM $\frac{1}{2}$ WATT1%M.F.	DALE RLO79303G
R15-18, 26-28, 54, 55, 64	RES. 4.7KOHM $\frac{1}{2}$ WATT5%C.F.	
30 R62	RES. 45.3KOHM $\frac{1}{2}$ WATT1%M.F.	DALE RN55D4532F
R30, 33	RES. 47OHM $\frac{1}{2}$ WATT5%C.F.	
R21	RES. 470OHM $\frac{1}{2}$ WATT5%C.F.	
R19	RES. 47KOHM $\frac{1}{2}$ WATT5%C.F.	
R35	RES. 510OHM $\frac{1}{2}$ WATT5%C.F.	
35 R43	RES. 6.2KOHM $\frac{1}{2}$ WATT5%C.F.	
R60	RES. 7.5KOHM $\frac{1}{2}$ WATT5%C.F.	
R37	RES. 75KOHM $\frac{1}{2}$ WATT5%C.F.	
R9	RES. 76KOHM $\frac{1}{2}$ WATT1%M.F.	DALE RN60D7682F
R11	RES. 820OHM $\frac{1}{2}$ WATT5%C.F.	
40 U2, 11, 14, 16, 22	RES. DIP NETWRK. 47KOHM	CT9 761-1R47K
C21, 41, 45	CAP. AXIAL 1MF@250VDC	MALLORY #TC56
C24	CAP. AXIAL 220MF@250VDC	MALLORY LP2219250C7P3
C10	CAP. AXIAL ALUM ELEC. 4700 0MF@25VDC	MALLORY TCG472U025NIC
45 C1, 2, 3, 55, 60	CAP. RADIAL DIPPED TANT. 10MF@25VDC	KEMET T350E106M025AS
C53	CAP. RADIAL DIPPED TANT. 1MF@35VDC	KEMET T350A105K035AS
50 C36	CAP. RADIAL DIPPED TANT. 47MF@10VDC	KEMET T350H566MC10AS

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Ref. Numeral 5 of Component	Description and Value	Manufacturer and Part No.
C54	CAP.RADIAL SILV MICA 100PF300VDC	KAHGAN SD5101J301
C57	CAP.RADIAL SILV MICA 20PF300VDC	KAHGAN SP12200J301
10 C49	CAP. RADIAL SILV. MICA 39PF300VDC	KAHGAN SP12390J301
C39	CAP.RADIAL X7R MLC .015MF@50VDC	KEMET C315C102K1R5CA
15 C6	CAP.RADIAL X7R MLC .022MF@50VDC	KEMET C315C223K5R5CA
C30,35,37	CAP.RADIAL Z5U MLC .015MF@50VDC	KEMET C315C153K5R5CA
C4,7	CAP.RADIAL 25U MLC .01MF@50VDC	KEMET C315C103K5R5CA
20 C4,5,6,9,11-19, 22,23,25-28 C31-34,37,42,43 47,48,50-52	CAP.RADIAL 25U MLC .22MF@50VDC	KEMET C322C224M5U5CA
25 C56,58,59		
C46	CAP.VARI.2-12PF.	JOHANSEN #9626
CR7,8,9,10, 11,12,17	DIODE SIL.	ITT.FAIRCHLD.1N4148
30 CR1,2,3,4	DIODE SIL.FAST	GENL.INST.ECP10D
CR5	DIODE SIL.FASTHIVOLT	GENL.INST.UF4007
CR6,13,15	DIODE SIL.REF.2,500VDC	NATL.SEMI-LM3852-2.5
CR14,16	DIODE SIL.ZENER3.8V.25WATT	MOTOROLA 1N4622A
U6,13,15,17	SWITCH 8 POSITION DIP	CTS 206-8
35 Q2,9,12	TRANSTOR.COMMON NPN	MOTOROLA 2N2222A
Q8,10,11	TRANSTOR.COMMON PNP	MOTOROLA 2N2907A
Q4	TRANSTOR.HIVOLTHIFREQ.NPN	MOTOROLA MPSU10
Q7	TRANSTOR.HIVOLTHIFREQ.PNP	MOTOROLA MPSU60
Q1	TRANSTOR.HIVOLTHIINPN	TI,MOTOROLATIP48
40 Q3,14	TRANSTOR.HIVOLTNPN2N3439	MOTOROLA 2N3439
Q13	TRANSTOR.HIVOLTPNP	MOTOROLA MJE5731
U5,27	IC 1-SHOT 74HC221	NATL.SEMI MM74HC221N
U23,26	IC 1-SHOT 74LS221	NATL.SEMI DM741S221N
U7-10	IC COMPARATOR 74HC688	NATL.SEMI MM74HC688N
45 U30	IC CONVERTER DAC0800	NATL.SEMI DAC0800LCN
U24,25	IC COUNTER 74HC193	NATL.SEMI MM74HC193N
U28	IC HI SLEW HI VOLT OP AMP	BURR-BROWN 3584JM
U1	IC HYBRID DC/DC CONVERTER	BURR-BROWN MODEL 724
U4	IC OC DRIVER SN7406	NATL.SEMI DM7406N
U3	IC OCTAL LATCH 74HC374	NATL. MM74HC374N
50 U12,29,31,32	IC OP AMP LF256	NATL.SEMI LF256H
U18,19,20,21	IC OPTO ISOLATOR	HEWLETT-PCKRD HCPL2300
R24,42,63	POT100KOHM $\frac{1}{4}$ WATT10%	BOURNS 3622-1-104
R38,49,52	POT10KOHM $\frac{1}{4}$ WATT10%	BOURNS 3622W-1-103
R20	POT25KOHM $\frac{1}{4}$ WATT10%	BOURNS 3622W-1-253
55 R14,31	POT2KOHM $\frac{1}{4}$ WATT10%	BOURNS 3622W-1-202

<u>Ref. Numeral of Component</u>	<u>Description and Value</u>	<u>Manufacturer and Part No.</u>
	VRI	NATL.LM340T-5.0
5	R10	RES.1MEGOHM $\frac{1}{2}$ WATT5%C.F.
	R2,4	RES.1.2KOHM $\frac{1}{2}$ WATT5%C.F.
	R32	RES.1.6KOHM $\frac{1}{2}$ WATT5%C.F.
	R44	RES.1.8KOHM $\frac{1}{2}$ WATT5%C.F.
	R1	RES.10MEGOHM $\frac{1}{2}$ WATT5%C.F.
10	R5,R22	RES.100HM $\frac{1}{2}$ WATT5%C.F.
	R65	RES.100KOHM $\frac{1}{2}$ WATT5%C.F.
	R59	RES.10KOHM $\frac{1}{2}$ WATT1%M.F.
	R100	RES.2700HM
	R101,108	RES.4700HM
15	R102,103	RES.1KOHM
	106,109,110	
	R104	RES.47000HM
	R105	PCT.100KOHM
	R107	POT.10KOHM
20	R111,113	RES.2200HM
	R112	RES.22CHM
	R114,115	RES. 470HM
	C100	CAP.10MF035 VPC
	C108	CAP.10C00 PF
25	D100	DIODE
	Q100,105	TRANSTOR
	Q101,102	TRANSTOR
	Q103,104	TRANSTOR
	U100,U108	IC 1-SHOT
30	U103,104	IC INVERTOR
	105,106	
	U108	IC LINE DECODER

Of course, it should be understood that a wide range of changes and modifications can be made to the preferred embodiments described above. For example, the transducer could be of a type other than piezo-electric such as magneto-strictive, electro-strictive, and electro-mechanical. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, which are intended to define the scope of this invention.

APPENDIX

5 Reagent Jet Printer
Reagent Calibration

PAGE 1
07-14-86
12:26:57
IBM Personal Computer BASIC Compiler V2.00

```

10 0030 0006 REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Reagent Calibration' $LINESIZE: 132
    0030 0006 'MODULE - "REACAL"
    0030 0006 '
    0030 0006 'AUTHOR - M. A. Enevold
    0030 0006 '
    0030 0006 'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
15 0030 0006 'REVISION - 2.0 07-01-86 NAE MicroFab modifications
    0030 0006 ' - 1.0 02-11-86 NAE Creation of initial code
    0030 0006 '
    0030 0006 'SYSTEM - This code can only be compiled by the BASCOM
    0030 0006 ' COMPILER, it will not run under the INTERPRETER!!
    0030 0006 '
20 0030 0006 'DESCRIPTION:
    0030 0006 ' The reagent calibrate module presents a menu with 12 items arranged
    0030 0006 ' in 3 columns of 4 rows. The arrow keys allow movement around the
    0030 0006 ' table, the + and - keys increment or decrement values in the first
    0030 0006 ' column, and the enter key executes commands in the third column.
    0030 0006 ' The second column is an array of ASCII strings representing reagent name,
25 0030 0006 ' concentration, density, and viscosity. The values entered in column one
    0030 0006 ' are drop frequency, pulse width, strobe delay, and nozzle number.
    0030 0006 ' The commands in the third column are start/stop, load, save, and exit.
    0030 0006 '
    0030 0006 'DATA DICTIONARY
    0030 0006 ' MENUZ Pointer to which menu item is active (0-11)
30 0030 0006 ' MENU$(17,1) Array for strings used to display the menu
    0030 0006 ' MENU(17,4) Array for numbers in the menu display
    0030 0006 ' DIFF1 Differential to move MENUZ at arrow key input
    0030 0006 ' TYPE1 Pointer set during main scan to direct action
    0030 0006 ' KEYBUF$ Storage for string input from menu display
    0030 0006 ' AS Destination for single keystroke inputs
35 0030 0006 ' FILES String where filename is built for reagent data file
    0030 0006 ' REANAMES String where reagent name is stored
    0030 0006 ' RZ Row to display special graphics character in menu
    0030 0006 ' CZ Column to display special graphics character in menu
    0030 0006 ' NZ Special graphics character is read into here
    0030 0006 ' OLD.AMP.VALUEZ Integer value for setting pulse amplitude
40 0030 0006 ' DIG.VALZ Value set to digital port 0 to inc/dec amplitude
    0030 0006 '
    0030 0006 SUB REAGENT.CALIBRATE STATIC
    0047 0006 DIM MENU$(17,1),MENU(17,4)
    0048 01FE
45 0048 01FE GOSUB INITIALIZE: 'read init. values and set screen
    004E 01FE
    004E 01FE WHILE TYPE1 <> 1
    0059 0200
    0059 0200 TYPE1 = 0
    0060 0200 AS = ""
50 006A 0204
    006A 0204 WHILE AS = ""
    0079 0204 AS = INKEY$
    0083 0204 IF ACTIVEZ = 1 AND DOWNTIME < TIMER THEN GOSUB PEN.DOWN
    00AD 0204 WEND
    0080 0204
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Reagent Jet Printer
Reagent Calibration

PAGE 2
07-14-86
12:26:57

Offset Data Source Line

IBM Personal Computer BASIC Compiler V2.00

```

25 00B0 020A      IF A$ = CHR$(13) THEN TYPEZ = 1:      'execute <cr>
    00CA 020A      IF A$ = "+" THEN TYPEZ = 2:      'increment variable
    00E0 020A      IF A$ = "-" THEN TYPEZ = 3:      'decrement variable
    00F6 020A      IF A$ = CHR$(0) + CHR$(72) THEN TYPEZ = 4:  'up arrow key
    011B 020A      IF A$ = CHR$(0) + CHR$(80) THEN TYPEZ = 5:  'down arrow key
    0140 020A      IF A$ = CHR$(0) + CHR$(75) THEN TYPEZ = 6:  'left arrow key
30 0165 020A      IF A$ = CHR$(0) + CHR$(77) THEN TYPEZ = 7:  'right arrow key
    018A 020A      IF A$ > CHR$(47) AND A$ < CHR$(123) THEN TYPEZ = 8: 'ascii 0 - z
    01C2 020A
    01C2 020A      ON TYPEZ GOSUB T1, T2, T3, T4, T5, T6, T7, T8
    01DB 020A
    01DB 020A      WEND
35 01DF 020A      TYPEZ = 0
    01E6 020A
    01E6 020A      EXIT SUB
    01EA 020A      REM $PAGE

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5 Reagent Jet Printer
Reagent Calibration

PAGE 3
07-14-86
12:26:57

IBM Personal Computer BASIC Compiler V2.00

```

Offset  Data  Source Line
10 01EA 020A ***** SUBROUTINES FOR THIS MODULE *****
01EA 020A
01EA 020A T1:      'cr> execute command
01EF 020A      IF MENUZ < 12 THEN TYPEZ = 0:RETURN:      'exit to print menu, no action
0205 020C      04 MENUZ - 11 GOSUB T1A, T1B, T1C, T1D
021A 020C      IF MENUZ < 15 THEN TYPEZ = 0
022C 020C      RETURN
15 0230 020C
0230 020C T1A:      'start/stop drop flow
0235 020C      IF MENU$(12,0) = "START" THEN GOSUB START.INK
025A 020C      IF MENU$(12,0) = "STOP " THEN GOSUB STOP.INK
027F 020C      MENU$(12,0) = TEMP$
20 029A 0210      COLOR 0,7:GOSUB DISPMENU
02AC 0210      RETURN
02B0 0210
02B0 0210 START.INK:
02B5 0210      TEMP$ = "STOP "
02BF 0210      CALL DOT.ON:      'in module PCI
25 02CB 0210      LOCATE 17,71:COLOR 27,0:PRINT "PRINTING";
02F1 0210      ACTIVEZ = 1
02FB 0210      RETURN
02FC 0210
02FC 0210 STOP.INK:
0301 0210      TEMP$ = "START"
30 030B 0210      CALL DOT.OFF:      'in module PCI
0317 0210      LOCATE 17,71:COLOR 15,0:PRINT " ";
033D 0210      ACTIVEZ = 0
0344 0210      RETURN
034B 0210
034B 0210 T1B:      'load reagent profile
35 034D 0210      IF MENU$(6,1) = "" THEN LOCATE 25,1:PRINT "Reagent Name is not specified";GOSUB ANYKEY:RETURN
0391 0210
0391 0210      GOSUB SEARCH
0397 0210
0397 0210      IF IZ < (REANUMZ + 1) THEN GOTO FOUND
03AB 0214      LOCATE 25,10-LEN(MENU$(6,1))/2:PRINT MENU$(6,1);" not Found";
40 0404 0214      GOSUB ANYKEY:      'wait for a keyhit
040A 0214      RETURN
040E 0214
040E 0214 FOUND:
0413 0214      FILES$ = RIGHT$(STR$(IZ),LEN(STR$(IZ))-1) + "REA.RJP"
0437 021B      OPEN FILES FOR INPUT AS #1:      'set pattern data file for read
45 044B 021B      INPUT #1,MENU(0,0):      'read frequency
046B 021B      INPUT #1,MENU(1,0):      'read amplitude
048B 021B      INPUT #1,MENU(2,0):      'read strobe delay
04AE 021B      INPUT #1,MENU(3,0):      'read pulse width
04D1 021B      INPUT #1,MENU(4,0):      'read rise time
04FA 021B      INPUT #1,MENU(5,0):      'read fall time
50 0519 021B
0519 021B      INPUT #1,MENU(7,1):      'read concentration
0530 021B      INPUT #1,MENU(8,1):      'read density
0561 021B      INPUT #1,MENU(9,1):      'read viscosity
0585 021B      INPUT #1,MENU(10,1):      'read surface tension
55 05A9 021B

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5 Reagent Jet Printer
Reagent Calibration

PAGE 4
07-14-86
12:26:57

IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
05A9	0218	CLOSE #1: 'done with data file
10 05B0	0218	
05B0	0218	OPEN "SEADef.RJP" FOR OUTPUT AS #1
05C2	0218	PRINT #1,FILES: 'save filename in default file
05D2	0218	PRINT #1,MENU\$(6,1): 'save the directory name as well
05F4	0218	CLOSE #1
05FB	0218	GOSUB DISP.PARMS: 'show all parameters
15 0601	0218	RETURN
0605	0218	
0605	0218	TIC: 'save reagent profile
060A	0218	IF MENU\$(6,1) = "" THEN LOCATE 25,1:PRINT "Reagent Name is not specified";GOSUB ANYKEY:RETURN
064E	0218	OPEN "READIR.RJP" FOR INPUT AS #1
065F	0218	INPUT #1,REANUMZ
20 0671	0218	CLOSE #1
0678	0218	IF REANUMZ < 80 THEN GOTO SAVE.REA
0687	0218	LOCATE 25,1:PRINT "Directory is Full (80 reagents max.)"
06A1	0218	GOSUB ANYKEY:RETURN
06AB	0218	SAVE.REA:
06B0	0218	GOSUB SEARCH
25 06B6	0218	IF IZ > REANUMZ THEN GOTO SAVEREA1
06C7	0218	REANUMZ = IZ
06CE	0218	COLOR 15,0
06DA	0218	LOCATE 25,1:PRINT MENU\$(6,1);" already exists. Replace it with new values? ";
070C	0218	AS = ""
0716	0218	WHILE AS = ""
30 0725	0218	AS = INKEY\$
072F	0218	WEND
0732	0218	LOCATE 25,1:PRINT SPACE\$(7);
074F	0218	IF AS = "Y" OR AS = "y" THEN GOTO REPLACE
0778	0218	RETURN
077C	0218	
35 077C	0218	SAVEREA1:
0781	0218	KILL "READIR.OLD": 'delete old backup directory
0788	0218	NAME "READIR.RJP" AS "READIR.OLD": 'save old directory
0792	0218	OPEN "READIR.OLD" FOR INPUT AS #1
07A3	0218	OPEN "READIR.RJP" FOR OUTPUT AS #2: 'set up new dir
40 07B5	0218	
07B5	0218	INPUT #1,REANUMZ: 'read number of dir entries
07C7	0218	REANUMZ = REANUMZ + 1: 'increase by 1
07D9	0218	WRITE #2,REANUMZ: 'save in new directory
07E1	0218	
07E1	0218	FOR I=1 TO REANUMZ - 1
45 07FA	021C	LINE INPUT #1,AS: 'read entry from old dir
0807	021C	PRINT #2,AS: 'write entry in new directory
0817	021C	NEXT I
0832	0220	
0832	0220	CLOSE #1
0839	0220	
50 0839	0220	PRINT #2,MENU\$(6,1): 'write new entry to new directory
085B	0220	CLOSE #2: 'done with directory
0862	0220	
0862	0220	REPLACE:
0867	0220	FILES = RIGHT\$(STR\$(REANUMZ),LEN(STR\$(REANUMZ))-1) + "REA.RJP"
088B	0220	

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Reagent Jet Printer
Reagent Calibration

PAGE 5
07-14-86
12:26:57

IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
10 088B	0220	OPEN FILES FOR OUTPUT AS #1: 'create new pattern data file
089D	0220	WRITE #1,MENU(0,0): 'store frequency
08BB	0220	WRITE #1,MENU(1,0): 'store amplitude
08DC	0220	WRITE #1,MENU(2,0): 'store strobe delay
08FD	0220	WRITE #1,MENU(3,0): 'store pulse width
091E	0220	WRITE #1,MENU(4,0): 'store rise time
15 093F	0220	WRITE #1,MENU(5,0): 'store fall time
0962	0220	
0962	0220	WRITE #1,MENU(7,1): 'store concentration
0984	0220	WRITE #1,MENU(8,1): 'store density
09A6	0220	WRITE #1,MENU(9,1): 'store viscosity
09CB	0220	WRITE #1,MENU(10,1): 'store surface tension
20 09EA	0220	
09EA	0220	CLOSE #1: 'done with data file
09F1	0220	
09F1	0220	OPEN "READER.RJP" FOR OUTPUT AS #1
0A03	0220	PRINT #1,FILES: 'save filename in default file
0A13	0220	PRINT #1,MENU(6,1): 'save the directory name as well
25 0A35	0220	CLOSE #1
0A3C	0220	RETURN
0A40	0220	
0A40	0220	SEARCH:
0A45	0220	OPEN "READIR.RJP" FOR INPUT AS #1
0A56	0220	INPUT #1,REANUMZ: 'read number of patterns in dir
30 0A6B	0220	IZ = 1: 'set entry pointer
0A6F	0220	
0A6F	0220	SLOOP:
0A74	0220	LINE INPUT #1,AS: 'read next pattern name from dir
0A81	0220	IF AS = MENU(6,1) THEN GOTO SEARCH.DONE: 'compare name with dir entry
0AA5	0220	IZ = IZ + 1
35 0AAE	0220	IF IZ < (REANUMZ + 1) THEN GOTO SLOOP: 'check for done
0AC1	0220	SEARCH.DONE:
0AC6	0220	CLOSE #1
0ACD	0220	RETURN
0AD1	0220	
40 0AD1	0220	T1B: 'return with no change to exit reagent calibrate
0AD6	0220	PRINT #3,"UH";
0AE6	0220	CLOSE #3: 'close com channel
0AEB	0220	RETURN
0AF1	0220	
0AF1	0220	T2: 'process "*" key
45 0AF6	0220	IF MENUZ > 5 THEN RETURN
0B05	0220	NEWTIME = TIMER
0B0F	0224	DELTA TIME = NEWTIME - OLDTIME
0B1F	022C	OLDTIME = NEWTIME
0B29	022C	IF DELTA TIME > 0.15 THEN MULTZ = 1 ELSE MULTZ = MULTZ + 1
0B4B	022E	IF MULTZ > 100 THEN MULTZ = 100
50 0B5B	022E	MENU(MENUZ,0) = MENU(MENUZ,0) + MENU(MENUZ,3) * MULTZ: 'add increment
0B7F	022E	IF MENU(MENUZ,0) > MENU(MENUZ,1) THEN MENU(MENUZ,0) = MENU(MENUZ,1): 'check max value
0C06	022E	COLOR 15,1:GOSUB DISPMENU:RETURN: 'show new value
0C1D	022E	
0C1D	022E	T3: 'process "-" key
0C22	022E	IF MENUZ > 5 THEN RETURN
55 0C31	022E	NEWTIME = TIMER

5
Reagent Jet Printer
Reagent Calibration

PAGE 6
07-14-86
12:26:37

IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
10 0C3B	022E	DELTA TIME = NEWTIME - OLDTIME
0C4B	022E	OLDTIME = NEWTIME
0C55	022E	IF DELTA TIME > 0.15 THEN MULTZ = 1 ELSE MULTZ = MULTZ + 1
0C77	022E	IF MULTZ > 100 THEN MULTZ = 100
0C89	022E	MENU(MENUZ,0) = MENU(MENUZ,0) - MENU(MENUZ,3) * MULTZ: 'sub increment
0CCB	022E	IF MENU(MENUZ,0) < MENU(MENUZ,2) THEN MENU(MENUZ,0) = MENU(MENUZ,2): 'check min value
15 0D32	022E	COLOR 15,1:GOSUB DISPMENU:RETURN: 'show new value
0D49	022E	
0D49	022E	T4: 'process up arrow key
0D4E	022E	IF MENUZ MOD 6 = 0 THEN RETURN: 'in top row already
0D63	022E	DIFFZ = -1:GOSUB NEWMENU:RETURN: 'move pointer up one
0D74	0230	
20 0D74	0230	T5: 'process down arrow key
0D79	0230	IF MENUZ MOD 6 = 5 THEN RETURN: 'in bottom row already
0D8F	0230	DIFFZ = 1:GOSUB NEWMENU:RETURN: 'move pointer down one
0DA0	0230	
0DA0	0230	T6: 'process left arrow key
0DAS	0230	IF INT(MENUZ / 6) = 0 THEN RETURN: 'in left column already
25 0DC5	0230	DIFFZ = -6:GOSUB NEWMENU:RETURN: 'move pointer one left
0DD6	0230	
0DD6	0230	T7: 'process right arrow key
0DD8	0230	IF INT(MENUZ / 6) = 2 THEN RETURN: 'in right column already
0DFE	0230	DIFFZ = 6:GOSUB NEWMENU:RETURN: 'move pointer one right
0E0F	0230	
30 0E0F	0230	T8: 'input keys into KEYBUF\$ until <cr> is entered
0E14	0230	IF MENUZ > 10 THEN RETURN
0E23	0230	LOCATE 25,30:COLOR 31,0:PRINT "ENTER NEW VALUE";:COLOR 15,0
0E55	0230	KEYBUF\$ = A\$
0E5F	0234	WHILE A\$ <> CHR\$(13)
0E72	0234	LOCATE 25,47:PRINT SPACES(15);
35 0E8F	0234	LOCATE 25,47:PRINT KEYBUF\$;
0EA9	0234	A\$ = ""
0EB3	0234	WHILE A\$ = ""
0EC2	0234	A\$ = INKEY\$
0ECC	0234	IF ACTIVEZ = 1 AND DOWNTIME < TIMER THEN GOSUB PEN.DOWN
0EF6	0234	WEND
40 0EF9	0234	IF A\$ = CHR\$(8) AND LEN(KEYBUF\$) > 0 THEN KEYBUF\$ = LEFT\$(KEYBUF\$,LEN(KEYBUF\$)-1)
0F3B	0234	IF A\$ = CHR\$(13) AND LEN(KEYBUF\$) < 15 THEN KEYBUF\$ = KEYBUF\$ + A\$
0F75	0234	WEND
0F79	0234	
0F79	0234	IF MENUZ > 5 THEN GOTO STORESTRNG
0F8B	0234	
45 0F8B	0234	TEMP = VAL(KEYBUF\$) 'temp has value of keys input
0F9B	0238	
0F9B	0238	'round off temp according to step size in menu array
0F9B	0238	TEMP = INT(TEMP / (MENU(MENUZ,3) + .5) * MENU(MENUZ,3)
0FD1	0238	
50 0FD1	0238	'test TEMP for maximum and minimum values in menu array
0FD1	0238	IF TEMP > MENU(MENUZ,1) THEN TEMP = MENU(MENUZ,1)
1019	0238	IF TEMP < MENU(MENUZ,2) THEN TEMP = MENU(MENUZ,2)
104F	0238	
104F	0238	'insert new value into menu array and update screen
104F	0238	MENU(MENUZ,0) = TEMP
55 106B	0238	LOCATE 25,30:PRINT SPACES(40);

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Reagent Jet Printer
Reagent Calibration

PAGE 7
07-14-86
12:26:57

IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
10	1088 0238	COLOR 0,7:GOSUB DISPMENU
	109A 0238	RETURN
	109E 0238	
	109E 0238	SIGARESTRING:
	10A3 0238	MENU\$(MENUZ,1) = KEYBUF\$
	10BF 0238	LOCATE 25,30:PRINT SPACES(40);
15	10DC 0238	COLOR 0,7:GOSUB DISPMENU
	10EE 0238	RETURN
	10F2 0238	
	10F2 0238	PEN.DOWN:
	10F7 0238	DOWNTIME = TIMER + 1
	1107 0238	PRINT #3,"D";
20	1117 0238	RETURN
	111B 0238	
	111B 0238	ANYKEY:
	1120 0238	LOCATE 25,64:PRINT "Strike any key..";
	113A 0238	AS = ""
	1144 0238	WHILE AS = ""
25	1153 0238	AS = INKEY\$
	115D 0238	WEND
	1160 0238	LOCATE 25,1:COLOR 15,0:PRINT SPACES(79);:COLOR 15,1
	1196 0238	RETURN
	119A 0238	
	119A 0238	NEWMENU: 'write old item in yellow, point to and highlight new item
30	119F 0238	COLOR 14,0:GOSUB DISPMENU
	11B1 0238	MENUZ = MENUZ + DIFFZ
	11BD 0238	IF MENUZ = 11 THEN MENUZ = 10
	11CF 0238	IF MENUZ > 15 THEN MENUZ = 15
	11E1 0238	COLOR 0,7:GOSUB DISPMENU:RETURN
	11F7 0238	
35	11F7 0238	INITIALIZE:
	11FC 0238	'change to second screen and display messages
	11FC 0238	SCREEN 0,0,1:COLOR 7,0:CLS:LOCATE 10,28:PRINT "Initializing Menu Display";
	1240 0238	LOCATE 12,33:PRINT "Please Wait..."
	125A 0238	
	125A 0238	'initialize variables
40	125A 0238	
	125A 0238	ACTIVEZ = 0: ' not printing
	1261 0238	
	1261 0238	'initialize plotter con channel
	1261 0238	
	1261 0238	OPEN "COM1:2400,N,8,2" AS #3
45	1273 0238	PRINT #3,"";UECS,EFV1,M";
	1283 0238	
	1283 0238	'initialize digital port
	1283 0238	SCRZ = 4
	128A 023A	CALL DIGITAL.OUT(SCRZ)
	129A 023A	SCRZ = 0
50	12A1 023A	CALL DIGITAL.OUT(SCRZ): 'pulse reset line to set amplitude to OV.
	12B1 023A	SCRZ = 4
	12B8 023A	CALL DIGITAL.OUT(SCRZ)
	12CB 023A	
	12CB 023A	'set hardware pulse width
55	12CB 023A	CALL SET.DOT.WIDTH(5) 'in module PCI

5 Reagent Jet Printer
Reagent Calibration

PAGE 8
07-14-86
12:26:57

IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
10C	12DE 023C	
	12DE 023C	'initialize menu arrays
	12DE 023C	RESTORE ARRDATA
	12E3 023C	FOR IZ=0 TO 17
	12E9 023C	READ MENU\$(IZ,0),MENU\$(IZ,1):
	1318 023C	READ MENU\$(IZ,1),MENU\$(IZ,2),MENU\$(IZ,3),MENU\$(IZ,4)
15	137C 023C	NEXT IZ
	138F 023C	
	138F 023C	'set default reagent values
	138F 023C	
	138F 023C	MENU(0,0) = 2000: 'frequency
	13AB 023C	MENU(1,0) = 0: 'amplitude
20	13C4 023C	MENU(2,0) = 1: 'strobe delay
	13E0 023C	MENU(3,0) = 090: 'pulse width
	13FC 023C	MENU(4,0) = 470: 'rise time
	1418 023C	MENU(5,0) = 070: 'fall time
	1436 023C	
	1436 023C	MENU(6,0) = 0: 'name
25	1452 023C	MENU(7,0) = 0: 'concentration
	146E 023C	MENU(8,0) = 0: 'density
	148A 023C	MENU(9,0) = 0: 'viscosity
	14A6 023C	MENU(10,0) = 0: 'surface tension
	14C2 023C	
	14C2 023C	OLD.AMP.VALUE? = 0 'initial value of 0 volts
30	14C9 023E	
	14C9 023E	'change active displayed screen to first screen to draw and display parameters
	14C9 023E	
	14C9 023E	SCREEN 0,0,0,1:CLS
	14E6 023E	
	14E6 023E	COLOR 13:LOCATE 1,32:PRINT "REAGENT CALIBRATE";
35	1507 023E	COLOR 9
	150E 023E	FOR I=2 TO 79
	1518 023E	LOCATE 3,1:PRINT "D";LOCATE 5,1:PRINT "M";LOCATE 19,1:PRINT "P";
	156F 023E	NEXT I
	158A 023E	FOR I=4 TO 18
	1594 023E	LOCATE 1,1:PRINT "J";LOCATE 1,28:PRINT " ";LOCATE 1,69:PRINT " ";LOCATE 1,80:PRINT "J";
40	1608 023E	NEXT I
	1626 023E	RESTORE TABLE
	162D 023E	FOR I=1 TO 12
	1637 023E	READ RI,CI,WI:LOCATE RI,CI:PRINT CHR\$(WI);
	166A 0244	NEXT I
	1685 0244	
45	1685 0244	'print three headings and instructions
	1685 0244	COLOR 10,0
	1691 0244	LOCATE 4,7:PRINT "DROP PARAMETERS";
	16AB 0244	LOCATE 4,39:PRINT "REAGENT PARAMETERS"
	16C3 0244	LOCATE 4,71:PRINT "COMMANDS";
	16DF 0244	
50	16DF 0244	COLOR 7:LOCATE 21,20:PRINT "Use ";COLOR 15:PRINT CHR\$(27);CHR\$(32);CHR\$(26);
	1729 0244	PRINT CHR\$(32);CHR\$(24);CHR\$(32);CHR\$(25);COLOR 7:PRINT " to position highlighted cursor";
	1768 0244	LOCATE 22,18:PRINT "Use ";COLOR 15:PRINT "+";COLOR 7:PRINT " or ";COLOR 15:PRINT "-";
	17BE 0244	COLOR 7:PRINT " to scroll current value up or down";
	17D2 0244	LOCATE 23,26:PRINT "Use ";COLOR 15:PRINT "DY";COLOR 7:PRINT " to activate selection";
55	1814 0244	

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Reagent Jet Printer
Reagent Calibration

PAGE 9

07-14-86

12:26:57

IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
25		
1814	0244	DISP.PARMS:
1819	0244	'display 18 menu choices in yellow
1819	0244	
1819	0244	COLOR 14,0
1825	0244	FOR MENUZ = 0 TO 17
30 1828	0244	GOSUB DISPMENU
1831	0244	NEXT MENUZ
1841	0244	
1841	0244	'set for reagent name and highlight it
1841	0244	MENUZ = 6:COLOR 0,7
1854	0244	GOSUB DISPMENU
35 185A	0244	
185A	0244	SCREEN 0,0,0,0
186F	0244	RETURN
1873	0244	REM \$PAGE

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Reagent Jet Printer
Reagent Calibration

PAGE 10
07-14-86
12:26:57

10 Offset Data Source Line

IBM Personal Computer BASIC Compiler V2.00

```

1673 0244 DISP MENU:
1678 0244 LOCATE (MENUZ MOD 6)*2+7,(INT(MENUZ/6)*28+2)+15*INT(MENUZ/12)
1804 0244 PRINT MENU$(MENUZ,0)
18F2 0244 IF MENUZ > 5 THEN GOTO SHOWSTRING: ' no value to display
15 1901 0244 LOCATE (MENUZ MOD 6)*2+7,MENU(MENUZ,4)
1933 0244 PRINT USING MENU$(MENUZ,1);MENU(MENUZ,0);
1966 0244 IF MENUZ > 2 THEN RETURN
1975 0244 ON MENUZ+1 GOSUB SET.FREQ, SET.AMP, SET.DELAY
1986 0244 RETURN
20 198A 0244 SHOWSTRING:
198F 0244 IF MENUZ > 10 THEN RETURN
19FE 0244 LOCATE (MENUZ MOD 6)*2+7,48
198A 0244 PRINT "
19C7 0244 LOCATE (MENUZ MOD 6)*2+7,48
19E3 0244 PRINT MENU$(MENUZ,1)
25 1A02 0244 RETURN
1A06 0244
1A06 0244 SET.FREQ:
1A0B 0244 TEMP = MENU(0,0)
1A24 0244 CALL SET.DOT.RATE(TEMP): 'in module PCI
1A34 0244 LEDZ = 3-INT((TEMP+500)/1000)
30 1A57 0246 IF LEDZ < 0 THEN LEDZ = 0
1A69 0246 SCRZ = 4 + (LEDZ * 32): 'set LED intensity
1A89 0246 CALL DIGITAL.OUT(SCRZ): 'in module PCI
1A99 0246 RETURN
1A9D 0246
1A9D 0246 SET.AMP:
35 1AA2 0246 SCRZ = CINT(MENU(MENUZ,0) * 255 / 150): 'convert volts to binary number
1ACB 0246 IF SCRZ = OLD.AMP.VALUEZ THEN RETURN
1ADC 0246 TEMPZ = SCRZ - OLD.AMP.VALUEZ: 'calculate delta
1AEB 0246 OLD.AMP.VALUEZ = SCRZ: 'update old value to current value
1AEF 0246 DIG.VALZ = 6
1AF6 024A IF TEMPZ < 0 THEN DIG.VALZ = 5
40 1B0B 024A TEMPZ = ABS(TEMPZ)
1B15 024A FOR IZ = 1 TO TEMPZ
1B22 024C SCRZ = DIG.VALZ + (32+LEDZ)
1B3F 024C CALL DIGITAL.OUT(SCRZ): 'pulse higher or lower
1B4F 024C SCRZ = 4 + (32 + LEDZ)
1B6F 024C CALL DIGITAL.OUT(SCRZ): 'set port to normal
45 1B7F 024C NEXT IZ
1B91 024C RETURN
1B95 024C
1B95 024C SET.DELAY:
1B9A 024C TEMP = MENU(2,0)
1BB6 024C CALL SET.STROBE.DELAY(TEMP): 'in module PCI
50 1BC6 024C RETURN
1BCA 024C
1BCA 024C REM $PAGE

```

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Reagent Jet Printer
 10 Reagent Calibration

PAGE 11
 07-14-86
 12:26:57

IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
1BCA	024C	***** DATA USED BY THIS MODULE *****
1BCA	024C	
15 1BCA	024C	ARRDATA:
1BCF	024C	DATA "Frequency" Hz,"###",10000,1,1,16
1BD1	024C	DATA "Amplitude" V,"###",150,0,1,19
1BD3	024C	DATA "Strobe Delay" uS,"###.###",15999.5,.5,.5,16
1BD5	024C	DATA "Pulse Width" ,"###",999,0,1,19
1BD7	024C	DATA "Rise Time" ,"###",999,0,1,19
20 1BD9	024C	DATA "Fall Time" ,"###",999,0,1,19
1BDB	024C	DATA "Name", "",0,0,0,0
1BDD	024C	DATA "Concentration", "",0,0,0,0
1BDF	024C	DATA "Density", "",0,0,0,0
1BE1	024C	DATA "Viscosity", "",0,0,0,0
1BE3	024C	DATA "Surface Tension", "",0,0,0,0
25 1BE5	024C	DATA "", "",0,0,0,0
1BE7	024C	DATA "START", "",0,0,0,0
1BE9	024C	DATA "LOAD", "",0,0,0,0
1BEB	024C	DATA "SAVE", "",0,0,0,0
1BED	024C	DATA "EXIT", "",0,0,0,0
1BEF	024C	DATA "", "",0,0,0,0
30 1BF1	024C	DATA "", "",0,0,0,0
1BF3	024C	
1BF3	024C	TABLE:
1BF8	024C	DATA 3,1,218
1BFA	024C	DATA 3,28,210
1BFC	024C	DATA 3,69,210
35 1BFE	024C	DATA 3,80,191
1C00	024C	DATA 5,1,198
1C02	024C	DATA 5,28,206
1C04	024C	DATA 5,69,206
1C06	024C	DATA 5,80,181
1C08	024C	DATA 19,1,192
40 1C0A	024C	DATA 19,28,208
1C0C	024C	DATA 19,69,208
1C0E	024C	DATA 19,80,217
1C10	024C	
1C10	024C	END SUB
1C17	024C	
45 1C17	024C	
23EB-	024C	

50426 Bytes Available
 43960 Bytes Free

50 0 Warning Error(s)
 0 Severe Error(s)

55

Reagent Jet Printer
Pattern Entry/Modification

PAGE 1
07-05-86
10:46:13

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0030 0006 REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Pattern Entry/Modif
      0030 0006 ication'
      0030 0006 'MODULE - "PATENT" Pattern creation, modification, and filing
      0030 0006 '
10     0030 0006 'AUTHOR - N. A. Enevold
      0030 0006 '
      0030 0006 'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
      0030 0006 '
15     0030 0006 'REVISION - 1.2 03-10-86 NAE Remove Mouse inputs
      0030 0006 '          1.1 02-20-86 NAE Add 80 pattern limit to save
      0030 0006 '          1.0 01-13-86 NAE Creation of initial code
      0030 0006 '
      0030 0006 'SYSTEM - This code can only be compiled by the BASCOM
20     0030 0006 '          COMPILER, it will not run under the INTERPRETER!!
      0030 0006 '
      0030 0006 'DESCRIPTION:
      0030 0006 '          This module allows the user to LOAD, SAVE, DIRectory, D
25     0030 0006 RAM and
      0030 0006 '          enter repeat count and other parameters for a pattern t
      0030 0006 o be printed.
      0030 0006 '          The low-resolution graphics mode is selected and a menu
      0030 0006 is displayed
30     0030 0006 '          across the bottom of the screen. Using arrow keys
      0030 0006 '          point to the action to be taken and then invoke that ac
      0030 0006 tion with the
      0030 0006 '          Enter key. In the DRAW mode, another menu is
      0030 0006 '          displayed which allows the user to select from LINE, RE
      0030 0006 CTangle,
35     0030 0006 '          Solid RECTangle, or CIRCLE pattern elements.
      0030 0006 '
      0030 0006 'DATA DICTIONARY
      0030 0006 '          SCNDATZ(50,5) 51 Row (Elements) by 6 Column array f
40     0030 0006 or storing pattern elements
      0030 0006 '          CURSORZ(9) Storage for cursor graphics icon
      0030 0006 '          MENU$(6) Up to 7 menu names can be saved here
      0030 0006 '          ELNUMZ Count of number of elements in a patt
      0030 0006 ern
      0030 0006 '          XZ YZ Current location of graphics cursor
45     0030 0006 '          GRID Value of one dot space on the screen
      0030 0006 (default is 0.005")
      0030 0006 '          ROWZ COLZ Location to print instructions
      0030 0006 '          AS Storage for single key-strokes or inp
50     0030 0006 ut strings
      0030 0006 '          MENUNUM Which menu is being displayed (1 or 2
      0030 0006 )
      0030 0006 '          ITEM Pointer to which menu item is highlig
      0030 0006 hted (0 - 6)
      0030 0006 '          REPEATZ Number of times pattern is to be repe
55     0030 0006 ated when printed
      0030 0006 '          XOFF YOFF X and Y axis distance between the pri
      0030 0006 nting of repeated patterns
      0030 0006 '          ROWSP COLSP Row and Column spacing for printing m
      0030 0006 ultiple sets of patterns

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Reagent Jet Printer
Pattern Entry/Modification

PAGE 2

07-05-86

10:46:13

IBM Personal Computer BASIC Compiler V2.00

20

0030 0006 ' PATNUMZ - Number of patterns stored in
the pattern directory PATDIR.RJP

0030 0006 ' DRONZ DCOLZ Row and Column location to display di
rectory entrys

0030 0006 ' NAME\$ Pattern name to be LOAded or SAvEd to
directory

25

0030 0006 ' IZ JZ Counters used to LOAD or SAVE the ele
ment data from/to pattern data file

0030 0006 ' FILE\$ Name of pattern data file

0030 0006 ' TEMP% Which type of element is being drawn.

30

1 = Line 2 = Rectangle

0030 0006 ' 3 = Solid Rectangle 4 = Circle

0030 0006 ' FLAG% Same as TEMP% above

0030 0006 ' STARTMSG\$ ENDMSG\$ Message display for startpoint and en
dpoint of element entry

35

0030 0006 ' X1Z Y1Z Starting cursor position for
element being drawn

0030 0006 ' DXZ DYZ Delta X and Y values used to
re-position cursor after arrow key

40

0030 0006 ' MAXITEM The highest number item in th
e current menu display

0030 0006 ' XS XE Starting and ending X position of the
menu highlighting blue box

0030 0006 ' RADIUSZ The calculated radius of a ci
rcle to be displayed

45

0030 0006 REM \$PAGE

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Reagent Jet Printer
Pattern Entry/Modification

PAGE 3

07-05-86

10:46:13

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10      Offset  Data      Source Line      IBM Personal Computer BASIC Compiler V2.00

      0030  0006      SUB PATENTRY STATIC
      0047  0006
      0047  0006          WIDTH 40:SCREEN 1:CLS
15      005F  0006          DIM SCNDATZ(50,5),CURSORZ(9),MENU$(6)
      0060  029A          ELNUMZ = 0:XL=0:YL=0:BRID = 0.005
      007F  02A4
      007F  02A4          LINE (0,0)-(6,6),,B
      00A1  02A4          LINE (0,3)-(6,3),,B
20      00C5  02A4          LINE (3,0)-(3,6),,B
      00E9  02A4          PRESET (3,3)
      00F5  02A4          GET (0,0)-(6,6),CURSORZ
      0116  02A4          CLS
      011D  02A4
25      011D  02A4          LINE (0,0)-(319,190),,B
      0140  02A4
      0140  02A4          RESTORE INSTRU
      0147  02A4          FOR I=1 TO 4
      0151  02A4              READ ROWZ,COLZ,A$
30      0164  02AC              LOCATE ROWZ,COLZ:PRINT A$;
      0180  02AC          NEXT I
      019B  02B0
      019B  02B0      FIRST:
      01A0  02B0          MENUNUM = 1
35      01AA  02B4          GOSUB SUBMENU
      01B0  02B4
      01B0  02B4          ON ITEM + 1 GOTO PATDIR, PATLOAD, PATSAVE, PATDRAW, REP
      EAT, PATEXT
      01CD  02B8          GOTO FIRST
40      01D0  02B8
      01D0  02B8      REPEAT:
      01D5  02B8          GOSUB ITEMBOXERASE: 'erase blue box around DIR
      01DB  02B8          LOCATE 25,1:PRINT SPACE$(39); 'erase menu line
      01FB  02B8          LOCATE 25,1:INPUT;"Enter Repeat Count ",REPEATZ
45      021B  02BA          LOCATE 25,1:PRINT SPACE$(39); 'erase menu line
      0235  02BA          LOCATE 25,1:INPUT;"Enter X Axis Offset ",XOFF
      0255  02BE          LOCATE 25,1:PRINT SPACE$(39); 'erase menu line
      0272  02BE          LOCATE 25,1:INPUT;"Enter Y Axis Offset ",YOFF
      0292  02C2          GOTO FIRST
50      0296  02C2      PATEXT:
      029B  02C2          WIDTH 80:SCREEN 0:CLS
      02B2  02C2          EXIT SUB
      02B6  02C2          REM $PAGE

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Reagent Jet Printer
Pattern Entry/Modification

PAGE 4
07-05-86
10:46:13

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

15

0286 02C2 PATDIR: 'list directory of patterns
028B 02C2 GOSUB ITEMEOXERASE: 'erase blue box around DIR
02C1 02C2 LOCATE 25,1:PRINT SPACE\$(39); 'erase menu line
02DE 02C2 OPEN "PATDIR.RJP" FOR INPUT AS #1: 'open directory
file

20

02EF 02C2 INPUT #1, PATNUMX: 'read number of patterns in dir
ectory
0301 02C4 LINE (1,1)-(318,189),0,BF: 'erase graphics tablet
0326 02C4 I = 0: 'set counter

25

0330 02C4 DISLOOP:
0335 02C4 I = I + 1: 'set for next value
0344 02C4 IF I > PATNUMX THEN GOTO DIREXIT: 'test for done
035B 02C4 IF INT((I-1)/44) <> (I-1)/44 THEN GOTO SHOWNEXT
0364 02C4 IF INT((I-1)/44) < 1 THEN GOTO SHOWNEXT
03A9 02C4 LOCATE 25,1:PRINT "More to Display. Continue ? (Y or N)

30

03C3 02C4 ";
03C9 02C4 GOSUB CORLOOP: 'wait for Y or N response
IF A\$ = "N" THEN GOTO DIREXIT: 'if N then don't contin
ue

35

03DC 02C4
03DC 02C4 LINE (1,1)-(318,189),0,BF: 'erase graphics tablet
0401 02C4
0401 02C4 SHOWNEXT:
0406 02C4 DROWX = ((I - 1) MOD 22) + 2: 'calculate row for disp
lay

40

0422 02C6 DCOLX = 4: 'set column to 4
0429 02C8 IF ((I - 1) MOD 44) > 21 THEN DCOLX = 23: 'reset column
if necessary

45

044C 02C8
044C 02C8 LINE INPUT #1, A\$: 'read next name from directory
0459 02C8 LOCATE DROWX,DCOLX:PRINT A\$; 'PRINT NAME
0475 02C8 GOTO DISLOOP

50

0479 02C8 DIREXIT:
047E 02C8 CLOSE #1: 'terminate access to PATDIR.RJP
0485 02C8 GOTO FIRST
0489 02C8
0489 02C8 REM \$PAGE

55

Reagent Jet Printer
Pattern Entry/Modification

PAGE 5
07-05-86
10:46:13

```

Offset  Data   Source Line      IBM Personal Computer BASIC Compiler V2.00

5
    04B9  02C3  PATLOAD:
    04BE  02C3          60SUB ITEMBOXERASE:      'erase blue box around DIR
    0494  02C3          OPEN "PATDIR.RJP" FOR INPUT AS #1
    04A5  02C3          INPUT #1,PATNUMZ:      'read number of patterns in dir
10    04B7  02C3          60SUB GETNAME:      'prompt for and input pattern n
                                use
    04BD  02C3          LINE (1,1)-(318,189),0,BF:      'erase graphics tablet
    04E2  02C3
    04E2  02C3          60SUB SEARCH
15    04E8  02C3
    04E8  02C3          IF IZ < (PATNUMZ + 1) THEN GOTO FOUND
    04FC  02C3          LOCATE 10,16-(LEN(NAME$)/2):PRINT NAME$;" not Found";
    0531  02CE          LOCATE 12,14:PRINT "Strike Any Key"
    054B  02CE          60SUB ANYKEY:      'wait for a keyhit
20    0551  02CE          GOTO FIRST
    0555  02CE
    0555  02CE          FOUND:
    055A  02CE          FILE$ = RIGHT$(STR$(IZ),LEN(STR$(IZ))-1) + "PAT.RJP"
    057E  02D2          OPEN FILE$ FOR INPUT AS #1:      'set pattern data file
25    for read
    058F  02D2          INPUT #1,ELNUMZ:      'read number of elements in pat
                                tern
    05A1  02D2          INPUT #1,GRID:      'read grid size
    05B3  02D2          INPUT #1,REPEATZ:      'read repeat count
30    05C5  02D2          INPUT #1,XOFF:      'read x axis offset for repeat
    05D7  02D2          INPUT #1,YOFF:      'read y axis offset for repeat
    05E9  02D2
    05E9  02D2          FOR IZ = 0 TO ELNUMZ - 1
    05F7  02D4          FOR JZ = 0 TO 5
35    05FD  02D4          INPUT #1,CONCATZ(IZ,JZ):'read file into screen
                                array
    0621  02D6          NEXT JZ
    0631  02D6          NEXT IZ
    0643  02D6          CLOSE #1:      'done with data file
40    064A  02D6
    064A  02D6          OPEN "PATDEF.RJP" FOR OUTPUT AS #1
    065C  02D6          PRINT #1,FILE$:      'save filename in defau
                                lt file
    066C  02D6          PRINT #1,NAME$:      'save the directory nam
                                e as well
45    067C  02D6          CLOSE #1
    0683  02D6
    0683  02D6          GOTO REDRAW
    0687  02D6
50    0687  02D6          SEARCH:
    068C  02D6          IZ = 1:      'set entry pointer
    0693  02D6          SLOOP:
    0698  02D6          LINE INPUT #1,A$:      'read next pattern name from di
                                r
55    06A5  02D6          IF A$ = NAME$ THEN GOTO SEARCH.END:      'compare name w
                                ith dir entry
    06B8  02D6          IZ = IZ + 1
    06C1  02D6          IF IZ < (PATNUMZ + 1) THEN GOTO SLOOP:'check for done
    06D4  02D6          SEARCH.END:

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Reagent Jet Printer
 Pattern Entry/Modification

PAGE 6
 07-05-86
 10:46:13

Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
06D9	02D6	CLOSE #1:	'not found so close file and display me
		ssage	
06ED	02D6	RETURN	
06E4	02D6		
06E4	02D6	REM \$PAGE	

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Reagent Jet Printer
Pattern Entry/Modification

PAGE 7
07-05-86
10:46:13

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      06E4 02D6 FATSARE:
      06E9 02D6      GOSUB ITEMEXERASE: 'erase blue box around DIR
      06EF 02D6      IF ELNUMZ = 0 THEN GOTO FIRST: 'no elements in pattern
      06FE 02D6      OPEN "PATDIR.RJP" FOR INPUT AS #1
10     070F 02D6      INPUT #1,PATNUMZ
      0721 02E6      IF PATNUMZ < 80 THEN GOTO SAVE.PAT: 'directory full
                                at 80 patterns
      0730 02D6      CLOSE #1
      0737 02D6      LOCATE 25,1:PRINT SPACE$(39);; 'erase bottom l
15     ine
      0754 02D6      LOCATE 25,1:PRINT "Directory is full (80 patterns max)"
      ;
      076E 02D6      GOSUB ANYKEY:GOTO FIRST
      0778 02D6      SAVE.PAT:
20     077D 02D6      GOSUB GETNAME: 'prompt for and get pattern name
      0783 02D6      GOSUB SEARCH
      0789 02D6      IF IZ > PATNUMZ THEN GOTO ADD.NEW.PATTERN
      079A 02D6      LINE (1,1)-(318,189),0,BF: 'erase graphics tablet
      07BF 02D6      LOCATE 10,13-(LEN(NAME$)/2):PRINT NAME$;" already exist
25     5.";
      07F4 02D6      LOCATE 12,15:PRINT "Replace it?"
      080E 02D6      PATNUMZ = IZ
      0815 02D6      AS = ""
      081F 02D6      WHILE AS = ""
30     082E 02D6          AS = INKEY$
      0838 02D6      WEND
      083B 02D6      IF AS = "Y" OR AS = "y" THEN GOTO SAVE.PATTERN
      0864 02D6      GOTO FIRST
      0868 02D6
35     0868 02D6      ADD.NEW.PATTERN:
      086D 02D6      KILL "PATDIR.OLD": 'delete old backup directory
      0874 02D6      NAME "PATDIR.RJP" AS "PATDIR.OLD": 'save old direc
                                tory
      087E 02D6      OPEN "PATDIR.OLD" FOR INPUT AS #1
      088F 02D6      OPEN "PATDIR.RJP" FOR OUTPUT AS #2: 'set up new dir
40     08A1 02D6      INPUT #1,PATNUMZ: 'read number of dir entries
      08B3 02D6      PATNUMZ = PATNUMZ + 1: 'increase by 1
      08BC 02D6      WRITE #2,PATNUMZ: 'save in new directory
      08CD 02D6      FOR I=1 TO PATNUMZ - 1
45     08E6 02DA          LINE INPUT #1,AS: 'read entry from old dir
      08F3 02DA          PRINT #2,AS: 'write entry in new directory
      0903 02DA      NEXT I
      091E 02DA      PRINT #2,NAME$: 'write new entry to new directo
                                ry
50     092E 02DA      CLOSE #1:CLOSE #2: 'done with directory
      093C 02DA      SAVE.PATTERN:
      0941 02DA      FILE$ = RIGHT$(STR$(PATNUMZ),LEN(STR$(PATNUMZ))-1) + "P
                                AT.RJP"
      0965 02DA      OPEN FILE$ FOR OUTPUT AS #1: 'create new pattern dat
55     a file
      0977 02DA      WRITE #1,ELNUMZ: 'store number of elements
      0988 02DA      WRITE #1,GRID: 'store grid dimension
      0998 02DA      WRITE #1,REPEATZ: 'store repeat count
      09A9 02DA      WRITE #1,XOFF: 'store x axis offset for repeat

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Reagent Jet Printer
Pattern Entry/Modification

PAGE 8
07-05-86
10:46:13

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

25

09B9 02DA WRITE #1,YOFF: 'store y axis offset for repeat
09C9 02DA FOR IZ = 0 TO ELNUMZ - 1
09D7 02DC FOR JZ = 0 TO 5
09DD 02DC WRITE #1,SCNDATZ(IZ,JZ): 'write screen a
rray to file

30

0A00 02DC NEXT JZ
0A10 02DC NEXT IZ
0A22 02DC CLOSE #1: 'done with data file
0A29 02DC OPEN "PATDEF.RJP" FOR OUTPUT AS #1
0A3B 02DC PRINT #1,FILE\$: 'save filename in default
file

35

0A4B 02DC PRINT #1,NAME\$: 'save the directory name as well

0A5B 02DC CLOSE #1
0A62 02DC GOTO FIRST
0A66 02DC REM \$PAGE

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Reagent Jet Printer
Pattern Entry/Modification

PAGE 9
07-05-86
10:46:13

	Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
5	0A66	02DC	PATDRAW:	
	0A6B	02DC	GOSUB ITEMBOXERASE	
	0A71	02DC	LINE (1,1)-(318,189),0,BF:	'Erase graphics tablet
	0A96	02DC		
10	0A96	02DC	NEXTEL:	
	0A9E	02DC	MENUNUM = 2	
	0AA5	02DC	GOSUB SUBMENU	
	0AAB	02DC		
	0AAB	02DC	ON ITEM + 1 GOTO ALINE, RECT, SRECT, ACIRCLE, REDRAW, B	
15			ACKUP	
	0ACB	02DC	GOTO NEXTEL	
	0ACB	02DC		
	0ACB	02DC	BACKUP:	
	0AD0	02DC	GOSUB ITEMBOXERASE	
20	0AD6	02DC	GOTO FIRST	
	0ADA	02DC		
	0ADA	02DC	ALINE:	
	0ADF	02DC	TEMP1 = 1	
	0AE6	02DE	STARTMSG\$ = "STARTING ENDPOINT"	
25	0AF0	02E2	ENDMSG\$ = "ENDING ENDPOINT "	
	0AFA	02E6	GOTO ENTERELEMENT	
	0AFE	02E6		
	0AFE	02E6	RECT:	
	0B03	02E6	TEMP1 = 2	
30	0B0A	02E6	GOTO RECTMSG	
	0B0E	02E6		
	0B0E	02E6	SRECT:	
	0B13	02E6	TEMP1 = 3	
	0B1A	02E6	RECTMSG:	
35	0B1F	02E6	STARTMSG\$ = "STARTING CORNER"	
	0B29	02E6	ENDMSG\$ = "ENDING CORNER "	
	0B33	02E6	GOTO ENTERELEMENT	
	0B37	02E6		
	0B37	02E6	ACIRCLE:	
40	0B3C	02E6	TEMP1 = 4	
	0B43	02E6	STARTMSG\$ = "CENTER OF CIRCLE"	
	0B4D	02E6	ENDMSG\$ = "POINT ON CIRCLE "	
	0B57	02E6		
	0B57	02E6	ENTERELEMENT:	
45	0B5C	02E6	GOSUB ITEMBOXERASE	
	0B62	02E6	FLAG1=0	
	0B69	02EB	LOCATE 25,1:PRINT SPACE\$(39);	
	0B86	02EB	LOCATE 25,1:PRINT STARTMSG\$;	
	0BA0	02EB	GOSUB DISPCURSOR	
50	0BA6	02EB	FINDSTART:	
	0BA8	02EB	GOSUB MOUSEACT	
	0B61	02EB	IF A\$ = CHR\$(27) THEN GOTO ABORT	
	0B08	02EB	IF A\$ = CHR\$(13) THEN GOTO SETSTART	
	0B0F	02EB	GOSUB CURSORMOVE	
	0B05	02EB	GOTO FINDSTART	
55	0BE2	02EB	ABORT:	
	0BED	02EB	GOSUB PLACECURSOR	
	0BF3	02EB	GOTO NEXTEL	
	0BF7	02EB		

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Reagent Jet Printer
Pattern Entry/Modification

PAGE 10
07-05-86
10:46:13

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Offset Data Source Line IEM Personal Computer BASIC Compiler V2.00

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08F7 02EB SETSTART:
08FC 02EB LOCATE 25,1:PRINT ENDMSG$:
0C16 02EB FLAG% = TEMP%:X1% = X%:Y1% = Y%
20 0C28 02EC IF FLAG% = 4 THEN PSET (X1+4,Y1+4)
0C55 02EC FINDEND:
0C5A 02EC GOSUB MOUSEACT
0C60 02EC IF A$ = CHR$(27) THEN GOTO CANCELEL
0C77 02EC IF A$ = CHR$(13) THEN GOTO SAVEEL
25 0C8E 02EC GOSUB CURSORMOVE
0C94 02EC GOTO FINDEND
0C97 02EC CANCELEL:
0C9C 02EC GOSUB PLACECURSOR
0CA2 02EC ON FLAG% GOSUB ER1, ER2, ER3, ER4
30 0CB3 02EC FLAG% = 0
0CBA 02EC GOTO NEXTEL
0CBE 02EC SAVEEL:
0CC3 02EC GOSUB PLACECURSOR
0CC9 02EC IF FLAG% = 4 THEN CIRCLE (X1+4,Y1+4),SQR((X-X1)^2+(
35 Y1-Y1)^2),,,,1
0D32 02EC GOSUB CORRECT
0D38 02EC IF A$="M" THEN GOTO REDRAW
0D4B 02EC STOREEL:
0D50 02EC SCNDAT$(ELNUM%,0) = FLAG%
40 0D6A 02EC SCNDAT$(ELNUM%,1) = X1%
0D85 02EC SCNDAT$(ELNUM%,2) = Y1%
0DA0 02EC SCNDAT$(ELNUM%,3) = X%
0DBB 02EC SCNDAT$(ELNUM%,4) = Y%
0DD6 02EC SCNDAT$(ELNUM%,5) = 0
45 0DEF 02EC ELNUM% = ELNUM% + 1
0DF8 02EC FLAG% = 0
0DFF 02EC GOTO NEXTEL
0E03 02EC REM $PAGE

```

Reagent Jet Printer
Pattern Entry/Modification

PAGE 11
07-05-86
10:46:13

	Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
5	3E03	02EC	REDRAW:	
	0E08	02EC	GOSUB ITEMBOXERASE	
	0E0E	02EC	LINE(1,1)-(318,189),0,BF	
	0E33	02EC	IF ELNUM% = 0 THEN GOTO NEXTEL	
10	0E42	02EC		
	0E42	02EC	FOR I=0 TO ELNUM%-1	
	0E5B	02F0	ON SCNDAT%(I,0) GOSUB RD1, RD2, RD3, RD4	
	0E81	02F0	NEXT I	
	0E9C	02F0	GOTO NEXTEL	
15	0EA0	02F0		
	0EA0	02F0	'***** Sub-routines called by main module *****	
	0EA0	02F0		
	0EA0	02F0	SUBMENU:	
	0EA5	02F0		
20	0EA5	02F0	LOCATE 25,1:PRINT SPACE\$(39):	
	0EC2	02F0	ON MENUNUM GOSUB MENU1, MENU2	
	0ED1	02F0		
	0ED1	02F0	FOR I=0 TO 6	
	0EDB	02F0	READ MENU\$(I)	
25	0EF2	02F0	LOCATE 25,(I*6)+2:PRINT MENU\$(I):	
	0F2B	02F0	NEXT I	
	0F46	02F0		
	0F46	02F0	READ MAXITEM	
	0F4D	02F4	ITEM = 0	
30	0F57	02F4		
	0F57	02F4	NEWITEM:	
	0F5C	02F4	GOSUB NEWITEMBOX	
	0F62	02F4		
	0F62	02F4	NEXTITEM:	
35	0F67	02F4	GOSUB ITEMSEARCH	
	0F6D	02F4	IF AS = CHR\$(13) THEN RETURN: ' ITEM has correct value	
	0F84	02F4	IF LEN(AS) < 2 THEN BEEP:GOTO NEXTITEM	
	0F9A	02F4	IF ASC(MID\$(AS,2,1)) = 75 THEN GOTO LEFTAR	
	0FB6	02F4	IF ASC(MID\$(AS,2,1)) = 77 THEN GOTO RIGHTAR	
40	0FD2	02F4	BEEP:GOTO NEXTITEM	
	0FD9	02F4		
	0FD9	02F4	LEFTAR:	
	0FDE	02F4	IF ITEM = 0 THEN GOTO NEXTITEM	
	0FEE	02F4	GOSUB ITEMBOXERASE	
45	0FF4	02F4	ITEM = ITEM - 1	
	1003	02F4	GOTO NEWITEM	
	1007	02F4		
	1007	02F4	RIGHTAR:	
	100C	02F4	IF ITEM = MAXITEM THEN GOTO NEXTITEM	
50	101F	02F4	GOSUB ITEMBOXERASE	
	1025	02F4	ITEM = ITEM + 1	
	1034	02F4	GOTO NEWITEM	
	1038	02F4		
	1038	02F4	MENU1:	
55	103D	02F4	RESTORE MN1	
	1044	02F4	RETURN	
	1048	02F4		
	1048	02F4	MENU2:	
	104D	02F4	RESTORE MN2	

Reagent Jet Printer
Pattern Entry/Modification

PAGE 12
07-05-86
10:46:13

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      1054 02F4      RETURN
      1058 02F4
      1058 02F4      ITEMSEARCH:
      105D 02F4      A$ = INKEY$:IF A$ <> "" THEN RETURN
      107A 02F4      GOTO ITEMSEARCH
10     107D 02F4      RETURN
      1081 02F4
      1081 02F4      NEWITEMBOX:
      1086 02F4      XS = (ITEM*48) + 7
      109C 02F8      YE = (ITEM*48) + 8 + LEN(MENU$(ITEM))*8
15     10D9 02FC      LINE (XS,191)-(XE,199),1,B
      1101 02FC      RETURN
      1105 02FC
      1105 02FC      ITEMBOXERASE:
      110A 02FC      LINE (XS,191)-(XE,199),0,B
20     1131 02FC      RETURN
      1135 02FC
      1135 02FC      PLACECURSOR:
      113A 02FC      PUT (XZ+1,YZ+1),CURSORZ
      1157 02FC      RETURN
25     115B 02FC
      115B 02FC      MOUSEACT:
      1160 02FC      GOSUB ANYKEY
      1166 02FC      DXZ = 0 : DYZ = 0
30     1174 0300      IF A$ = CHR$(0) + CHR$(72) THEN DYZ = -1:RETURN
      119D 0300      IF A$ = CHR$(0) + CHR$(60) THEN DYZ = 1:RETURN
      11C6 0300      IF A$ = CHR$(0) + CHR$(77) THEN DXZ = 1:RETURN
      11EF 0300      IF A$ = CHR$(0) + CHR$(75) THEN DXZ = -1:RETURN
      1218 0300      IF A$ = "8" THEN DYZ = -20:RETURN
      1232 0300      IF A$ = "2" THEN DYZ = 20:RETURN
35     124C 0300      IF A$ = "4" THEN DXZ = -20:RETURN
      1266 0300      IF A$ = "6" THEN DXZ = 20:RETURN
      1280 0300      IF A$ = CHR$(27) THEN RETURN
      1297 0300      IF A$ = CHR$(13) THEN RETURN
      12AE 0300      GOTO MOUSEACT
40     12B2 0300
      12B2 0300      CURSCRMOVE:
      12B7 0300      GOSUB PLACECURSOR
      12BD 0300      ON FLAGZ GOSUB ER1, ER2, ER3, ER4
45     12CE 0300      XZ = XZ + DXZ : YZ = YZ + DYZ
      12E6 0300      IF XZ < 0 THEN XZ = 0
      12F8 0300      IF XZ > 311 THEN XZ = 311
      1308 0300      IF YZ < 0 THEN YZ = 0
      131D 0300      IF YZ > 182 THEN YZ = 182
50     1330 0300      ON FLAGZ GOSUB DR1, DR2, DR3, DR4
      1341 0300      GOSUB DISPCURSOR
      1347 0300      RETURN
      134B 0300
      134B 0300      CORRECT:
      1350 0300      LOCATE 25,1:PRINT SPACE$(39);
55     136D 0300      LOCATE 25,1:PRINT "IS THIS CORRECT? (Y or N) ";
      1387 0300      CORLOOP:
      138C 0300      GOSUB ANYKEY
      1392 0300      IF A$ = "y" OR A$ = "Y" THEN A$ = "Y":GOTO COREXIT

```

Reagent Jet Printer
Pattern Entry/Modification

PAGE 13
07-05-86
10:46:13

IBM Personal Computer BASIC Compiler V2.00

	Offset	Data	Source Line
5	13C5	0300	IF A\$ = "n" OR A\$ = "N" THEN A\$ = "N":GOTO COREXIT
	13F8	0300	GOTO CORLOOP
	13FB	0300	COREXIT:
	1400	0300	LOCATE 25,1:PRINT SPACE\$(39);
10	141D	0300	RETURN
	1421	0300	
	1421	0300	DISPCURSOR:
	1426	0300	GOSUB PLACECURSOR
	142C	0300	LOCATE 25,27:PRINT USING "+#.###";XZ * GRID;
15	1456	0300	PRINT " ,";
	1463	0300	PRINT USING "+#.###";YZ * GRID;
	1480	0300	RETURN
	1484	0300	
	1484	0300	
20	1484	0300	RD1:
	1489	0300	LINE(SCNDATZ(I,1)+4,SCNDATZ(I,2)+4)-(SCNDATZ(I,3)+4,SCN DATZ(I,4)+4)
	1522	0300	RETURN
	1526	0300	
25	1526	0300	RD2:
	152B	0300	LINE(SCNDATZ(I,1)+4,SCNDATZ(I,2)+4)-(SCNDATZ(I,3)+4,SCN DATZ(I,4)+4),,B
	15C4	0300	RETURN
	15C8	0300	
30	15C8	0300	RD3:
	15CD	0300	LINE(SCNDATZ(I,1)+4,SCNDATZ(I,2)+4)-(SCNDATZ(I,3)+4,SCN DATZ(I,4)+4),,BF
	1667	0300	RETURN
	166B	0300	
35	166B	0300	RD4:
	1670	0300	RADIUSZ = SQR((SCNDATZ(I,3)-SCNDATZ(I,1))^2 + (SCNDATZ(I,4)-SCNDATZ(I,2))^2)
	16FF	0302	CIRCLE (SCNDATZ(I,1)+4,SCNDATZ(I,2)+4),RADIUSZ,,,1
	175D	0302	RETURN
40	1761	0302	
	1761	0302	DR1:
	1766	0302	LINE (X1Z+4,Y1Z+4)-(XZ+4,YZ+4)
	17AF	0302	RETURN
	17B3	0302	
45	17B3	0302	DR2:
	17B8	0302	LINE (X1Z+4,Y1Z+4)-(XZ+4,YZ+4),,B
	1801	0302	RETURN
	1805	0302	
	1805	0302	DR3:
50	180A	0302	LINE (X1Z+4,Y1Z+4)-(XZ+4,YZ+4),,BF
	1854	0302	RETURN
	1858	0302	
	1858	0302	DR4:
	185D	0302	RETURN
55	1861	0302	
	1861	0302	ER1:
	1866	0302	LINE (X1Z+4,Y1Z+4)-(XZ+4,YZ+4),0
	18AF	0302	RETURN
	18B3	0302	

Reagent Jet Printer
 Pattern Entry/Modification

PAGE 14
 07-05-86
 10:46:13

Offset Data Source Line iEM Personal Computer BASIC Coapiler V2.00

```

1883 0302 ER2:
1888 0302 LINE (X1Z+4,Y1Z+4)-(XZ+4,YZ+4),0,B
1901 0302 RETURN
1905 0302
1905 0302 ER3:
190A 0302 LINE (X1Z+4,Y1Z+4)-(XZ+4,YZ+4),0,BF
1954 0302 RETURN
1958 0302
1959 0302 ER4:
195D 0302 RETURN
1961 0302
1961 0302 ANYKEY:
1966 0302 A$ = ""
1970 0302 WHILE A$ = ""
197F 0302 A$ = INKEY$
1989 0302 WEND
198C 0302 RETURN
1990 0302
1990 0302 GETNAME: 'prompt for and get filename
1995 0302 LOCATE 25,1:PRINT SPACE$(39);
1998 0302 LOCATE 25,38:PRINT "<:"; 'boundry chevron
19CC 0302 LOCATE 25,1:PRINT "Enter Pattern Name ";
19E6 0302 LINE INPUT; "",NAME$
19F4 0302 RETURN
19FB 0302
19FB 0302 ' Data fields used by this module
19FB 0302
19FB 0302 MN1:
19FD 0302 DATA "DIR","LOAD","SAVE","DRAW","REPT","EXIT","",5
19FF 0302
19FF 0302 MN2:
1A04 0302 DATA "LINE","RECT","ERECT","CIRCL","REDRW","MAIN","",5
1A06 0302
1A06 0302 INSTRU:
1A0B 0302 DATA 8,16,"USE ARROWS"
1A0D 0302 DATA 10,9,"TO SELECT FROM THE MENU"
1A0F 0302 DATA 14,12,"USE THE ENTER KEY"
1A11 0302 DATA 16,10,"TO ACTIVATE SELECTION"
1A13 0302
1A13 0302 END SUB
1A1A 0302
21AF 0302

```

50426 Bytes Available
 43373 Bytes Free

0 Warning Error(s)
 0 Severe Error(s)

Reagent Jet Printer
Burr-Brown PCI-20000 custom driver

PAGE 1
06-30-86
08:38:16

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0030 0006 REM $TITLE:'Reagent Jet Printer' $SUBTITLE:'Burr-Brown PCI-2000
      0030 0006 0 custom driver'
      0030 0006 'MODULE - "PCI" Driver for the PCI-20000 I/O and PULSE cards
      0030 0006 '
10     0030 0006 'AUTHOR - M. S. Fairchild of Computing Architects Inc.
      0030 0006 '
      0030 0006 ' 113 Fairfield Way
      0030 0006 ' Bloomingdale, IL 60108
      0030 0006 ' 312/980-6777
      0030 0006 '
15     0030 0006 'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
      0030 0006 '
      0030 0006 'REVISION - 1.2 12-16-85 MSF Add digital I/O initialization, and
      0030 0006 output routine
      0030 0006 '
20     0030 0006 ' - 1.1 12-10-85 MSF Move counter module to position 2
      0030 0006 '
      0030 0006 ' - 1.0 11-22-85 MSF Creation of initial code
      0030 0006 '
      0030 0006 'SYSTEM - This code can only be compiled by the BASCOM V2
25     0030 0006 ' COMPILE, it will not run under the INTERPRETER!!
      0030 0006 '
      0030 0006 'DESCRIPTION:
      0030 0006 ' The PCI module is a group of routines used to a
      0030 0006 ccess
30     0030 0006 ' the BURR-Brown PCI-20000 board. The supplied software c
      0030 0006 auses
      0030 0006 ' the Wordstar2000 software to malfunction and will not p
      0030 0006 rvide
      0030 0006 ' explicit on, off functions for the counters. Custom dr
35     0030 0006 ivers
      0030 0006 ' will be made to provide all of the desired functions.
      0030 0006 '
      0030 0006 '
      0030 0006 ' Address Register
40     0030 0006 ' &HC0000 Carrier I.D. / module present (R)
      0030 0006 ' &HC0040 Module interrupt status (R)
      0030 0006 ' &HC0080 Digital I/O port 0 (R/W)
      0030 0006 ' &HC0081 Digital I/O port 1 (R/W)
      0030 0006 ' &HC0082 Buffer direction and enable (R/W)
45     0030 0006 ' &HC0083 Control for ports 0 and 1 (W)
      0030 0006 ' &HC00C0 Digital I/O port 2 (R/W)
      0030 0006 ' &HC00C1 Digital I/O port 3 (R/W)
      0030 0006 ' &HC00C3 Control for ports 2 and 3 (W)
      0030 0006 '
50     0030 0006 ' &HC0200 Read module I.D. (1110 1010)
      0030 0006 ' &HC0204 Rate generator low-order 16 bits (0)
      0030 0006 ' &HC0205 Rate generator high-order 16 bits (1)
      0030 0006 ' &HC0206 Counter 3 count register (2)
      0030 0006 ' &HC0207 Rate generator/counter 3 control
      0030 0006 ' &HC0208 Counter 0 count register (0)
55     0030 0006 ' &HC0209 Counter 1 count register (1)
      0030 0006 ' &HC020A Counter 2 count register (2)
      0030 0006 ' &HC020B Counter 0 - 2 control
      0030 0006 ' &HC020C Counter gate control (1 enables, 0 disa

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Reagent Jet Printer
Burr-Brown PCL-20000 custom driver

PAGE 2

06-30-86

08:38:16

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

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blaze:

Offset	Data	Source Line	bit	function
0030	0006	.	0	Rate generator gate
0030	0006	.	1	Rate generator gate
0030	0006	.	2	Counter 0 gate
0030	0006	.	3	Counter 1 gate
0030	0006	.	4	Counter 2 gate
0030	0006	.	5	Counter 3 gate
0030	0006	.	6	Not used
0030	0006	.	7	Not used

25

0030 0006
0030 0006 DATA DICTIONARY
0030 0006
0030 0006 COUNT - Divisor to 2Mhz rate to give desired frequency or time
0030 0006 COUNTHZ - High order 16 bits of a 32 bit divisor
0030 0006 COUNTLZ - Low order 16 bits of a 32 bit divisor
0030 0006 LSBZ - Lower 8 bits of a 16 bit divisor
0030 0006 MSBZ - Upper 8 bits of a 16 bit divisor

30

35

0030 0006 Main line code
0030 0006 The main line code is never executed. It's sole purpose is to

40

0030 0006 declare shared the variables that will be used in the subroutines
0030 0006 so that they will all be defined and hold their values.

45

0030 0006 MAIN:_
0030 0006 DIM SHARED COUNT,COUNTHZ,COUNTLZ,LSBZ,MSBZ

0030 0006 MAINLOOP:_
0030 0006 GOTO MAINLOOP

004C 0012
004C 0012 REM \$PAGE

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Reagent Jet Printer
Burr-Brown PCI-20000 custom driver

PAGE 3
06-30-86
08:38:16

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Offset  Data  Source Line      IBM Personal Computer BASIC Compiler V2.00

5
004C 0012 'SUBROUTINE - PCI.INIT
004C 0012 '
004C 0012 'DESCRIPTION:
004C 0012 ' The PCI.INIT subroutine initializes the PCI hardware.
10
004C 0012
004C 0012 SUB PCI.INIT STATIC
0053 0012
0053 0012 DEF SEG = &H0000: 'Point segment to PCI-20000 board
005A 0012
005A 0012 POKE &H020C,&H00: 'Disable all software enabled counter
15
0063 0012
0063 0012 ' Configure rate generator to 2 Mhz
0063 0012
0063 0012 POKE &H0207,&H34: 'Set low rate counter to mode 2
20
006D 0012 POKE &H0207,&H74: 'Set high rate counter to mode 2
0077 0012 POKE &H0204,&H02: 'Load low rate counter with 16 bits o
f 2
0081 0012 POKE &H0204,&H00
008A 0012 POKE &H0205,&H02: 'Load high rate counter with 16 bits
25
of 2
0094 0012 POKE &H0205,&H00
009D 0012 POKE &H020C,&H03: 'Enable rate counters
00A7 0012
00A7 0012 ' Configure dot rate counters (default to 5 Khz)
30
00A7 0012
00A7 0012 POKE &H020B,&H34: 'Set low dot counter (0) to mode 2
00B1 0012 POKE &H020B,&H74: 'Set high dot counter (1) to mode 2
00BB 0012 POKE &H0206,&H04: 'Load low rate counter with 16 bits o
35
f 4
00C5 0012 POKE &H020B,&H00
00CE 0012 POKE &H0209,&H64: 'Load high rate counter with 16 bits
of 100
00DB 0012 POKE &H0209,&H00
40
00E1 0012
00E1 0012 ' Configure dot pulse with one shot (default to 13 usec)
00E1 0012
00E1 0012 POKE &H0209,&H82: 'Set dot pulse with oneshot (2) to mo
de 1
45
00EB 0012 POKE &H020A,&H1A: 'Load oneshot with 16 bits of 26
00F5 0012 POKE &H020A,&H00
00FE 0012
00FE 0012 ' Configure shifted strobe pulse one shot (default to .5 usec)
00FE 0012
00FE 0012 POKE &H0207,&H82: 'Set shifted strobe onshot (3) to mod
50
e 1
010B 0012 POKE &H0206,&H01: 'Load oneshot with 16 bits of 1
0112 0012 POKE &H0206,&H00
011B 0012
011B 0012 ' Configure port 0 to output and port 1 to input
55
011B 0012
011B 0012 POKE &H0083,&H82: ' Set up I/O chip
0125 0012 POKE &H0082,&H34: ' Set up direction and enable buffers
012F 0012 POKE &H0080,&H00: ' Dissable print head

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Reagent Jet Printer

Burr-Brown PE1-20000 custom driver

PAGE 4

06-30-86

08:38:16

IBM Personal Computer BASIC Compiler V2.00

0136 0012 END SUB

013F 0012

013F 0012 REM \$PAGEIF:12

013F 0012 'SUBROUTINE - DOT.ON

013F 0012

013F 0012 'DESCRIPTION:

013F 0012 ' The DOT.ON subroutine enables the dot frequency counter
5.

013F 0012

013F 0012 SUB DOT.ON STATIC

0146 0012

0146 0012 POKE &H020C,&H0F: 'Enable dot counters and rate generat
or

0150 0012

0150 0012 END SUB

0157 0012

0157 0012 REM \$PAGEIF:12

0157 0012 'SUBROUTINE - DOT.OFF

0157 0012

0157 0012 'DESCRIPTION:

0157 0012 ' The DOT.OFF subroutine disables the dot counters

0157 0012

0157 0012 SUB DOT.OFF STATIC

015E 0012

015E 0012 POKE &H020C,&H03: 'Disable dot counters and enable rate
generator

0168 0012

0168 0012 END SUB

016F 0012

016F 0012 REM \$PAGEIF:49

Reagent Jet Printer
Burr-Brown PCI-20000 custom driver

PAGE 5
06-30-86
08:38:16

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

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016F 0012 'SUBROUTINE - SET.DOT.RATE
016F 0012 '
10 016F 0012 'DESCRIPTION:
016F 0012 ' The SET.DOT.RATE subroutine loads the dot rate counters
016F 0012 ' with the desired dot frequency. Allowed range is 10,000 to 1
    Hz.
016F 0012 ' The FREQ parameter is a real number in Hz.
15 016F 0012
016F 0012 SUB SET.DOT.RATE(FREQ) STATIC
0176 0012
0176 0012 ' Limit frequency to in range
0176 0012
20 0176 0012 IF FREQ < 1 THEN FREQ = 1
018F 0012 IF FREQ > 10000 THEN FREQ = 10000
01A8 0012
01A8 0012 ' Convert to count and check for 16 bit count or 32 bit count
01A8 0012
25 01A8 0012 COUNT = 2E6 / FREQ
01B8 0012 IF COUNT < 65536! THEN GOTO DIVIDE16 ELSE GOTO DIVIDE32
01CF 0012
01CF 0012 ' Process count of 32 bits
01CF 0012
30 01CF 0012 DIVIDE32:
01D0 0012 COUNTLZ = INT((COUNT/32768!) + 1): 'Stage lower count
01F0 0012 COUNTHZ = INT(COUNT/COUNTLZ): 'Form upper count
020B 0012 GOTO SET.COUNT
020F 0012
35 020F 0012 ' Process count of 16 bits
020F 0012
020F 0012 DIVIDE16:
0214 0012 COUNTLZ = 2
021B 0012 COUNTHZ = INT(COUNT/2)
40 0232 0012 GOTO SET.COUNT
0236 0012
0236 0012 ' Send the derived counts out to the counters
0236 0012
0236 0012 SET.COUNT:
45 0237 0012 LSBZ = COUNTLZ MOD 256: ' Send out low 16 bits
0248 0012 MSBZ = INT(COUNTLZ / 256)
0263 0012 POKE &H020B,LSBZ
0273 0012 POKE &H020B,MSBZ
0283 0012
50 0283 0012 LSBZ = COUNTHZ MOD 256: 'Send out high 16 bits
0291 0012 MSBZ = INT(COUNTHZ / 256)
02AC 0012 POKE &H0209,LSBZ
028C 0012 POKE &H0209,MSBZ
02CC 0012
55 02CC 0012 END SUB
02D3 0012
02D3 0012 REM $PAGEIF:27

```

5

10

Reagent Jet Printer
Burr-Brown PCI-20000 custom driver

PAGE 6

06-30-86

08:38:16

15

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

20

```
02D3 0012 'SUBROUTINE - SET.DOT.WIDTH
02D3 0012 '
02D3 0012 'DESCRIPTION:
02D3 0012 ' The SET.DOT.WIDTH subroutine loads the dot width one sh
ot
02D3 0012 ' with the desired dot pulse width. Allowed range is .5 to 16,0
00 usec.
```

25

```
' The dwidth parameter is a real number in usec.
```

```
02D3 0012
02D3 0012 SUB SET.DOT.WIDTH(DWIDTH) STATIC
02DA 0012
```

```
' Limit width to in range
02DA 0012
```

30

```
02DA 0012 IF DWIDTH < .5 THEN DWIDTH = .5
02F3 0012 IF DWIDTH > 16000 THEN DWIDTH = 16000
030C 0012
```

```
' Convert to count
030C 0012
```

35

```
030C 0012 COUNT = DWIDTH / .5
031A 0012
```

```
' Send the derived count out to the counter
031A 0012
```

40

```
031A 0012 LSB% = INT(COUNT MOD 256): ' Send out 16 bits
0331 0012 MSB% = INT(COUNT / 256)
```

```
0348 0012 POKE &H020A,LSB%
0358 0012 POKE &H020A,MSB%
```

```
0368 0012
0368 0012 END SUB
```

45

```
036F 0012
036F 0012 REM $PAGEIF:27
```

50

55

Reagent Jet Printer
Burr-Brown PCI-20000 custom driver

PAGE 7
06-30-86
08:38:16

5	Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
	036F	0012	'SUBROUTINE - SET.STROBE.DELAY	
	036F	0012	'	
	036F	0012	'DESCRIPTION:	
10	036F	0012	' The SET.STROBE.DELAY subroutine loads the strobe delay	
			one shot	
	036F	0012	' with the desired strobe delay time. Allowed range is .5 to 16	
			,000 usec.	
	036F	0012	' The delay parameter is a real number in usec.	
15	036F	0012		
	036F	0012	SUB SET.STROBE.DELAY(DELAY) STATIC	
	0376	0012		
	0376	0012	' Limit delay to in range	
	0376	0012		
20	0376	0012	IF DELAY < .5 THEN DELAY = .5	
	038F	0012	IF DELAY > 16000 THEN DELAY = 16000	
	03A8	0012		
	03A8	0012	' Convert to count	
	03A8	0012		
25	03A8	0012	COUNT = DELAY / .5	
	03B6	0012		
	03B6	0012	' Send the derived count out to the counter	
	03B6	0012		
	03B6	0012	LSBZ = INT(COUNT MOD 256): ' Send out 16 bits	
30	03CD	0012	MSBZ = INT(COUNT / 256)	
	03E4	0012	POKE &H0206,LSBZ	
	03F4	0012	POKE &H0206,MSBZ	
	0404	0012		
	0404	0012	END SUB	
35	040B	0012		
	040B	0012	REM \$PAGEIF:16	
	040B	0012	'SUBROUTINE - DIGITAL.OUT	
	040B	0012	'	
	040B	0012	'DESCRIPTION:	
40	040B	0012	' The DIGITAL.OUT subroutine sends the passed integer to	
			the output	
	040B	0012	' port 0.	
	040B	0012		
	040B	0012	SUB DIGITAL.OUT(BYTEZ) STATIC	
45	0412	0012		
	0412	0012	' Send the byte to the port	
	0412	0012		
	0412	0012	POKE &H0080,BYTEZ	
	0423	0012		
50	0423	0012	END SUB	
	042A	0012		
	057F	0012		

50426 Bytes Available
48723 Bytes Free

0 Warning Error(s)
0 Severe Error(s)

5

Reagent Jet Printer
Pattern Printing

PAGE
09-1
06:4

IBM Personal Computer BASIC Compiler V

```

10  Offset  Data  Source Line
      0030 0006 REM $TITLE: 'Reagent Jet Printer' $SUBTITLE: 'Pattern Printing' $LINESIZE:132
      0030 0006 'MODULE - "PATPRINT"
      0030 0006 '
      0030 0006 'AUTHOR - M. A. Enevold
      0030 0006 '
15  0030 0006 'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
      0030 0006 '
      0030 0006 'REVISION - 2.0 07-02-86 MAE Modified for MicroFab Printhead
      0030 0006 '      - 1.1 03-07-86 MAE Added notes and final touches
      0030 0006 '      - 1.0 02-03-86 MAE Creation of initial code
      0030 0006 '
20  0030 0006 'SYSTEM - This code can only be compiled by the BASCOM
      0030 0006 '      COMPILER, it will not run under the INTERPRETER!!
      0030 0006 '
      0030 0006 'DESCRIPTION:
      0030 0006 '      The printing module displays a menu in 3 columns of 4 rows each. The first
25  0030 0006 '      column has data from the default reagent profile. The second column has
      0030 0006 '      data from the default pattern file. The third column has standard printing
      0030 0006 '      data. The four arrow keys allow different menu items to be highlighted and
      0030 0006 '      the values can be changed with the + or - keys or by entering the new number
      0030 0006 '      followed by Enter. P will cause the pattern to be printed, S will select the
      0030 0006 '      notepad, and E will exit to the main program. On the notepad, any single line
30  0030 0006 '      entered here will be sent to the printer. A null line exits the notepad.
      0030 0006 '
      0030 0006 'DATA DICTIONARY
      0030 0006 '      MENU1 Which menu item is highlighted (0-17)
      0030 0006 '      DIFF1 Where to move menu highlight in response to arrow key
      0030 0006 '      TYPE1 What key has been pressed during main scan
35  0030 0006 '      ELZ1 Number of elements in current pattern
      0030 0006 '      SCAT1(50,5) Array for storing elements in current pattern
      0030 0006 '      REPEAT1 Counter for repeat printing the pattern
      0030 0006 '      CT1 Counter for stepping through the pattern array during printing
      0030 0006 '      RADIUS1 Radius of circle during printing
      0030 0006 '      I1 Y1 Offsets for start row/column position
40  0030 0006 '      REP11 REP12 Repeat distances for repeat printing of patterns
      0030 0006 '      S11 S12 Starting X and Y positions for solid rectangles
      0030 0006 '      E11 E12 Ending X and Y positions for solid rectangles
      0030 0006 '      I1 J1 Counters used for reading pattern files into the array
      0030 0006 '      TEMP1 Register for misc. integers
      0030 0006 '      NOTELINE1 Pointer to which line is active in the notepad
45  0030 0006 '      MENU$(17,1) Array of strings used to display menu items
      0030 0006 '      A$ Single keystroke input destination
      0030 0006 '      NOTE$ String entered in notepad and sent to printer
      0030 0006 '      KEYBUF$ String entered from main scan and assigned to number of string field
      0030 0006 '      REAXNAME$ Name of default reagent
      0030 0006 '      PATNAME$ Name of default pattern
50  0030 0006 '      FILE$ Name of reagent data file and then pattern data file
      0030 0006 '      MENU(11,4) Array of values used in displaying menu item numbers
      0030 0006 '      TEMP Register for the temporary storage of real numbers
      0030 0006 REM $PAGE

```

55

5 Reagent Jet Printer
Pattern Printing

PAGE
09-1'
08:4'

IBM Personal Computer BASIC Compiler V.

Offset	Data	Source Line
0030	0006	SUB PATPRINT STATIC
0047	0006	
0047	0006	DIM SCDAT\$(50,5),MENU\$(17,1),MENU(17,4)
0048	0462	
0048	0462	GOSUB INITIALIZE: 'read init. values and set screen
004E	0462	
004E	0462	WHILE TYPEZ <> 1
0059	0464	
0059	0464	TYPEZ = 0
0060	0464	AS = ""
006A	0468	
006A	0468	WHILE AS = ""
0079	0468	AS = INKEY\$
0083	0468	WEND
0086	0468	
0086	0468	IF AS = "E" OR AS = "e" THEN TYPEZ = 1: 'exit sub
00B2	0468	IF AS = "P" OR AS = "p" THEN TYPEZ = 2: 'print pattern
00DE	0468	IF AS = "+" THEN TYPEZ = 3: 'increment variable
00F4	0468	IF AS = "-" THEN TYPEZ = 4: 'decrement variable
010A	0468	IF AS = CHR\$(0) + CHR\$(72) THEN TYPEZ = 5: 'up arrow key
012F	0468	IF AS = CHR\$(0) + CHR\$(80) THEN TYPEZ = 6: 'down arrow key
0154	0468	IF AS = CHR\$(0) + CHR\$(75) THEN TYPEZ = 7: 'left arrow key
0179	0468	IF AS = CHR\$(0) + CHR\$(77) THEN TYPEZ = 8: 'right arrow key
019E	0468	IF AS > CHR\$(47) AND AS < CHR\$(58) THEN TYPEZ = 9: 'number 0-9
01D6	0468	IF AS = "S" OR AS = "s" THEN TYPEZ = 10: 'enter scratchpad
0202	0468	
0202	0468	ON TYPEZ GOSUB T1, T2, T3, T4, T5, T6, T7, T8, T9, T10
021F	0468	
021F	0468	WEND
0223	0468	TYPEZ = 0
022A	0468	
022A	0468	EXIT SUB
022E	0468	
022E	0468	***** SUBROUTINES FOR THIS MODULE *****
022E	0468	T10: 'scratch pad
0233	0468	SCREEN 0,0,2,2:COLOR 7,0
0256	0468	LOCATE NOTELINEZ,1
0264	046A	NOTELOOP:
0269	046A	LINE INPUT NOTES
0277	046E	IF NOTES = "" THEN SCREEN 0,0,0,0:RETURN
029F	046E	LPRINT NOTES
02AC	046E	IF NOTELINEZ < 24 THEN NOTELINEZ = NOTELINEZ + 1
02C0	046E	GOTO NOTELOOP
02C3	046E	
02C3	046E	T1:
02C8	046E	RETURN: 'exit to print menu, no action
02CC	046E	
02CC	046E	T3:
02D1	046E	'process "+" key
033C	0470	IF MENU(MENUZ,0) >= MENU(MENUZ,1) THEN MENU(MENUZ,0) = MENU(MENUZ,1):RETURN: 'check max value
0372	0470	MENU(MENUZ,0) = MENU(MENUZ,0) + MENU(MENUZ,3): 'add increment
0388	0470	COLOR 0,7:GOSUB DISPMENU:RETURN: 'show new value
0388	0470	T4:
0388	0470	'process "-" key

5 Reagent Jet Printer
Pattern Printing

PAGE
C9-17
08:49

	Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2
	038C	0470	IF MENU(MENU,0) <= MENU(MENU,2) THEN MENU(MENU,0) = MENU(MENU,2):RETURN:	'check min value
10	03F8	0470	MENU(MENU,0) = MENU(MENU,0) - MENU(MENU,3):	'sub increment
	042E	0470	COLOR 0,7:GOSUB DISPMENU:RETURN:	'show new value
	0444	0470		
	0444	0470	T5: 'process up arrow key	
	0449	0470	IF MENU MOD 6 = 0 THEN RETURN:	'in top row already
	045E	0470	DIFF1 = -1:GOSUB NEWMENU:RETURN:	'move pointer up one
15	046F	0472		
	046F	0472	T6: 'process down arrow key	
	0474	0472	IF MENU MOD 6 = 5 THEN RETURN:	'in bottom row already
	048A	0472	DIFF2 = 1:GOSUB NEWMENU:RETURN:	'move pointer down one
	0498	0472		
20	0498	0472	T7: 'process left arrow key	
	04A0	0472	IF INT(MENU / 6) = 0 THEN RETURN	'in left column already
	04C0	0472	DIFF3 = -6:GOSUB NEWMENU:RETURN:	'move pointer one left
	04D1	0472		
	04D1	0472	T8: 'process right arrow key	
	04D6	0472	IF INT(MENU / 6) = 2 THEN RETURN	'in right column already
25	04F9	0472	DIFF4 = 6:GOSUB NEWMENU:RETURN:	'move pointer one right
	050A	0472		
	050A	0472	T9: 'input keys into KEYBUF\$ until <cr> is entered	
	050F	0472	LOCATE 25,30:COLOR 31,0:PRINT "ENTER NEW VALUE";:COLOR 15,0	
	0541	0472	KEYBUF\$ = ""	
	054B	0476	WHILE AS <> CHR\$(13)	
30	055E	0476	LOCATE 25,47:PRINT SPACES(20);	
	057B	0476	LOCATE 25,47:PRINT KEYBUF\$;	
	0595	0476	AS = ""	
	059F	0476	WHILE AS = ""	
	05AE	0476	AS = INKEY\$	
	05BB	0476	WEND	
35	05BB	0476	IF AS = CHR\$(8) AND LEN(KEYBUF\$) > 0 THEN KEYBUF\$ = LEFT\$(KEYBUF\$,LEN(KEYBUF\$)-1)	
	05FD	0476	IF AS > CHR\$(31) THEN KEYBUF\$ = KEYBUF\$ + AS	
	061E	0476	WEND	
	0622	0476	TEMP = VAL(KEYBUF\$)	'temp has value of keys input
	0632	047A		
	0632	047A	'round off temp according to step size in menu array	
40	0632	047A	TEMP = INT(TEMP / (MENU(MENU,3) + .5) * MENU(MENU,3)	
	066B	047A		
	066B	047A	'test TEMP for maximum and minimum values in menu array	
	066B	047A	IF TEMP > MENU(MENU,1) THEN TEMP = MENU(MENU,1)	
	06AA	047A	IF TEMP < MENU(MENU,2) THEN TEMP = MENU(MENU,2)	
	06E9	047A		
45	06E9	047A	'insert new value into menu array and update screen	
	06E9	047A	MENU(MENU,0) = TEMP	
	0705	047A	LOCATE 25,30:PRINT SPACES(40);	
	0722	047A	COLOR 0,7:GOSUB DISPMENU	
	0734	047A	RETURN	
	0738	047A		
50	0738	047A	T2: 'set Burr-Brown board then print desired pattern	
	075D	047A		
	075D	047A	BEEP:COLOR 15,0:LOCATE 25,1	
	075A	047A	PRINT "Set Potentiometers on Printer....then Press any Key";	
	0767	047A	AS = ""	
55	0771	047A	WHILE AS = ""	

5 Reagent Jet Printer
Pattern Printing

PAGE
09-17
08:49

IBM Personal Computer BASIC Compiler V2

Offset	Data	Source Line
	0780 047A	AS = INKEY\$
10	078A 047A	WEND
	078D 047A	LOCATE 25,1:PRINT SPACE\$(79);
	07AA 047A	
	07AA 047A	'enter drop parameters into burr-brown board
	07AA 047A	TEMP = MENU(0,0):CALL SET.DOT.RATE(TEMP)
	07D3 047A	TEMP = 5:CALL SET.DOT.WIDTH(TEMP)
15	07ED 047A	TEMP = MENU(2,0):CALL SET.STROBE.DELAY(TEMP)
	0619 047A	CALL DOT.ON
	0825 047A	
	0825 047A	TEMPZ = 4
	082C 047C	CALL DIGITAL.OUT(TEMPZ)
	083C 047C	TEMPZ = 0: 'pulse RESET line
20	0843 047C	CALL DIGITAL.OUT(TEMPZ)
	0853 047C	TEMPZ = 4
	085A 047C	CALL DIGITAL.OUT(TEMPZ)
	086A 047C	
	086A 047C	JZ = CINT(MENU(1,0) * 255 / 150): 'set pulse amplitude by pulsing HIGHER signal JZ number of times
25	0893 047E	FOR IZ = 1 TO JZ
	08A0 0480	TEMPZ = 6: 'set HIGHER true
	08A7 0480	CALL DIGITAL.OUT(TEMPZ)
	08B7 0480	TEMPZ = 4: 'set HIGHER false
	08BE 0480	CALL DIGITAL.OUT(TEMPZ)
	08CE 0480	NEXT IZ
30	08E0 0482	
	08E0 0482	'establish CGM1: and initialize plotter
	08E0 0482	OPEN "CGM1:2400,N,8,2,CS 65535" AS #1
	08F2 0482	PRINT #1,";:UECS,EFV1,M";
	0902 0482	
	0902 0482	'move nozzle offset and establish new origin
35	0902 0482	PRINT #1,"A0";
	0912 0482	
	0912 0482	'calculate row/column location, move there, and set new origin
	0912 0482	IX = (MENU(12,0)-1) * (MENU(14,0) / 0.005)
	0954 0484	YZ = (MENU(13,0)-1) * (MENU(15,0) / 0.005)
	0996 0486	PRINT #1,IX,YZ;"D";
40	09B4 0486	
	09B4 0486	'print the pattern using repeat count
	09B4 0486	REPLYZ = MENU(8,0) / 0.005
	09D7 0488	REPIZ = MENU(9,0) / 0.005
	09FA 048A	
	09FA 048A	FOR REPEATZ = 0 TO MENU(7,0)
45	0A1C 048C	
	0A1C 048C	'print the pattern
	0A1C 048C	FOR CTZ = 0 TO ELNUMZ - 1
	0A2A 0490	ON SCNDATX(CTZ,0) GOSUB PLINE, PRECT, FSRECT, PCIRCL
	0A4C 0492	NEXT CTZ
	0A5E 0492	
50	0A5E 0492	PRINT #1,"A,0,0,"; 'return to origin
	0A6E 0492	PRINT #1,REPIZ;REPLYZ;"D"; 'move to next pattern
	0A8C 0492	NEXT REPEATZ
	0AA1 0494	
	0AA1 0494	PRINT #1,"H"; 'return plotter to original HOME
	0AB1 0494	

55

5 Reagent Jet Printer
Pattern Printing

PAGE

09-17

08:49

Offset: Data Source Line

IBM Personal Computer BASIC Compiler V2

```

0AB1 0494      CLOSE #1:      'disable com1:
10 0AB8 0494
0AB8 0494      RETURN
0ABC 0494
0ABC 0494      PLINE:
0AC1 0494      PRINT #1,SCNDATZ(CTZ,2);SCNDATZ(CTZ,1);"D";
0B03 0494      PRINT #1,SCNDATZ(CTZ,4);SCNDATZ(CTZ,3);"U";
15 0B45 0494      RETURN
0B49 0494
0B49 0494      PRECT:
0B4E 0494      PRINT #1,SCNDATZ(CTZ,2);SCNDATZ(CTZ,1);"D";
0B50 0494      PRINT #1,SCNDATZ(CTZ,4);SCNDATZ(CTZ,1);
0BCC 0494      PRINT #1,SCNDATZ(CTZ,4);SCNDATZ(CTZ,3);
20 0C08 0494      PRINT #1,SCNDATZ(CTZ,2);SCNDATZ(CTZ,3);
0C44 0494      PRINT #1,SCNDATZ(CTZ,2);SCNDATZ(CTZ,1);"U";
0CB6 0494      RETURN
0CBA 0494
0CBA 0494      PCIRCL:
0CBF 0494      RADIUSZ = SQR((SCNDATZ(CTZ,3)-SCNDATZ(CTZ,1))^2 + (SCNDATZ(CTZ,4)-SCNDATZ(CTZ,2))^2)
25 0D1A 0496      PRINT #1,"CC ";SCNDATZ(CTZ,2);SCNDATZ(CTZ,1);RADIUSZ;
0D63 0496      RETURN
0D67 0496
0D67 0496      PSRECT:
0D6C 0496      SIX = SCNDATZ(CTZ,4):EIX = SCNDATZ(CTZ,2)
0DA0 0496      SYZ = SCNDATZ(CTZ,3):EYZ = SCNDATZ(CTZ,1)
30 0DD4 049E      IF EIX <= SIX THEN SIX = SCNDATZ(CTZ,2):EIX = SCNDATZ(CTZ,4)
0E15 049E      IF EYZ <= SYZ THEN SYZ = SCNDATZ(CTZ,1):EYZ = SCNDATZ(CTZ,3)
0E56 049E
0E56 049E      PRINT #1,SIX;SYZ;"D";
0E74 049E
0E74 049E      IF EIX - SIX >= EYZ - SYZ THEN GOSUB STEPY ELSE GOSUB STEPX
35 0E9D 049E
0E9D 049E      PRINT #1,"U";
0EAD 049E      RETURN
0EB1 049E
0EB1 049E      STEPY:
40 0EB6 049E      PRINT #1,EIX;SYZ;
0ECE 049E      SYZ = SYZ + 1
0ED7 049E      IF SYZ > EYZ THEN RETURN
0EEB 049E      PRINT #1,EIX;SYZ;SIX;SYZ;
0F0E 049E      SYZ = SYZ + 1
0F17 049E      IF SYZ > EYZ THEN RETURN
45 0F2B 049E      PRINT #1,SIX;SYZ;
0F40 049E      GOTO STEPY
0F44 049E
0F44 049E      STEPX:
0F49 049E      PRINT #1,SIX;EYZ;
0F61 049E      SIX = SIX + 1
50 0F6A 049E      IF SIX > EIX THEN RETURN
0F7B 049E      PRINT #1,SIX;EYZ;SIX;SYZ;
0FA1 049E      SIX = SIX + 1
0FAA 049E      IF SIX > EIX THEN RETURN
0FBB 049E      PRINT #1,SIX;SYZ;
0FD3 049E      GOTO STEPX
55

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5 Reagent Jet Printer
Pattern Printing

PAGE
09-17
08:49

IBM Personal Computer BASIC Compiler V2

Offset	Data	Source Line
0FD7	049E	
70 0FD7	049E	NEWMENU: 'write old item in yellow, point to and highlight new item
0FDC	049E	COLOR 14,0:GOSUB DISPMENU
0FEE	049E	MENUZ = MENUZ + DIFFZ
0FFA	049E	IF MENUZ = 10 THEN MENUZ = 9
100C	049E	IF MENUZ = 11 THEN MENUZ = 9
101E	049E	IF MENUZ > 15 THEN MENUZ = 15
15 1030	049E	COLOR 0,7:GOSUB DISPMENU:RETURN
1046	049E	
1046	049E	INITIALIZE:
104B	049E	'change to screen 0 and display messages
104B	049E	SCREEN 0,0,1,1:COLOR 7,0:CLS:LOCATE 10,17:PRINT "Loading selected Reagent and Pattern Data Files";
10BF	049E	LOCATE 12,33:PRINT "Please Wait..."
20 10A9	049E	
10A9	049E	'initialize notepad on screen 2
10A9	049E	SCREEN 0,0,2,1:CLS:COLOR 15
10CE	049E	PRINT "Digital Notepad - - All information typed here is sent to the printer"
10DB	049E	NOTELINEZ = 3
25 10E2	049E	
10E2	049E	'initialize menu arrays
10E2	049E	RESTORE ARRDATA
10E9	049E	FOR IZ=0 TO 17
10EF	049E	READ MENUZ(IZ,0),MENUZ(IZ,1):
111F	049E	READ MENUZ(IZ,1),MENUZ(IZ,2),MENUZ(IZ,3),MENUZ(IZ,4)
30 1180	049E	NEXT IZ
1193	049E	
1193	049E	'get default reagent file and read values
1193	049E	
1193	049E	OPEN "REAGEF.RJP" FOR INPUT AS #1
11A4	049E	INPUT #1,FILES
35 11B6	04A2	INPUT #1,REANAMES
11CB	04A6	CLOSE #1
11CF	04A6	
11CF	04A6	OPEN FILES FOR INPUT AS #1: 'get reagent data
11E0	04A6	INPUT #1,MENU(0,0): 'frequency
1200	04A6	INPUT #1,MENU(1,0): 'amplitude
40 1223	04A6	INPUT #1,MENU(2,0): 'strobe delay
1246	04A6	INPUT #1,MENU(3,0): 'pulse width
1269	04A6	INPUT #1,MENU(4,0): 'rise time
128C	04A6	INPUT #1,MENU(5,0): 'fall time
12B1	04A6	CLOSE #1
12B8	04A6	
45 12B8	04A6	'get default pattern file and read values
12B8	04A6	
12B8	04A6	OPEN "PATDEF.RJP" FOR INPUT AS #1
12C9	04A6	INPUT #1,FILES
12DB	04A6	INPUT #1,PATNAMES
12ED	04AA	CLOSE #1
50 12F4	04AA	
12F4	04AA	OPEN FILES FOR INPUT AS #1: 'get pattern data
1305	04AA	INPUT #1,ELNUZZ
1317	04AA	INPUT #1,MENU(6,0): 'grid
133A	04AA	INPUT #1,MENU(7,0): 'repeat count
135D	04AA	INPUT #1,MENU(8,0): 'x offset

5 Reagent Jet Printer
Pattern Printing

PAGE
09-17
08:49

Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2
1380	04AA	INPUT #1,MENU(9,0):	'y offset
10 13A3	04AA	FOR IZ = 0 TO ELNUMZ-1	
13B1	04AC	FOR JZ = 0 TO 5	
13B7	04AC	INPUT #1,SCNDATZ(IZ,JZ)	
13DB	04AC	NEXT JZ	
13EB	04AC	NEXT IZ	
13FD	04AC	CLOSE #1	
15 1404	04AC		
1404	04AC	'set remaining parameters in menu array	
1404	04AC		
1404	04AC	MENU(12,0) = 1:	'row 1
1420	04AC	MENU(13,0) = 1:	'column 1
143C	04AC	MENU(14,0) = 0:	'row spacing
20 145B	04AC	MENU(15,0) = 0:	'column spacing
1474	04AC		
1474	04AC	'change active displayed screen to screen 0 to draw and display parameters	
1474	04AC		
1474	04AC	SCREEN 0,0,0,1:CLS	
25 1491	04AC		
1491	04AC	COLOR 13:LOCATE 1,32:PRINT "REAGENT PRINTING";	
14B2	04AC	COLOR 9	
14B9	04AC	FOR I=2 TO 79	
14C3	04AC	LOCATE 3,1:PRINT CHR\$(196);:LOCATE 5,1:PRINT CHR\$(205);:LOCATE 10,1:PRINT CHR\$(196);	
1523	04B0	NEXT I	
30 153E	04B0	FOR I=4 TO 17	
154B	04B0	LOCATE 1,1:PRINT CHR\$(179);:LOCATE 1,28:PRINT CHR\$(186);:LOCATE 1,54:PRINT CHR\$(186);:LOCATE 1,5	
		PRINT CHR\$(179);	
15C8	04B0	NEXT I	
15E6	04B0	RESTORE TABLE	
15ED	04B0	FOR I=1 TO 12	
35 15F7	04B0	READ RZ,CZ,NZ:LOCATE RZ,CZ:PRINT CHR\$(NZ);	
162A	04B6	NEXT I	
1645	04B6		
1645	04B6	'display 16 menu choices in yellow	
1645	04B6		
1645	04B6	COLOR 14,0	
40 1651	04B6	FOR MENUZ = 0 TO 15	
1657	04B6	GOSUB DISPMENU	
165D	04B6	NEXT MENUZ	
166D	04B6		
166D	04B6	'set for first menu entry and highlight it	
166D	04B6	MENUZ = 0:COLOR 0,7	
45 1680	04B6	GOSUB DISPMENU	
1686	04B6		
1686	04B6	'print three headings and instructions	
1686	04B6	COLOR 10,0	
1692	04B6	LOCATE 4,14.5-LEN(REANAME\$)/2:PRINT REANAME\$;	
16C1	04B6	LOCATE 4,41-LEN(PATNAME\$)/2:PRINT PATNAME\$;	
50 16F0	04B6	LOCATE 4,60:PRINT "PRINT LOCATION";	
170A	04B6		
170A	04B6	COLOR 7:LOCATE 19,20:PRINT "Use ";:COLOR 15:PRINT CHR\$(27);CHR\$(32);CHR\$(26);	
1754	04B6	PRINT CHR\$(32);CHR\$(24);CHR\$(32);CHR\$(25);:COLOR 7:PRINT " to position highlighted cursor";	
1793	04B6	LOCATE 20,18:PRINT "Use ";:COLOR 15:PRINT "+";:COLOR 7:PRINT " or ";:COLOR 15:PRINT "-";	
17E9	04B6	COLOR 7:PRINT " to scroll current value up or down";	

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Reagent Jet Printer
Pattern Printing

PAGE
09-17-
08:49:

Offset Data Source Line

IBM Personal Computer BASIC Compiler V2.

```

25 17FD 04B6      LOCATE 21.5:PRINT "Use ";:COLOR 15:PRINT "P";:COLOR 7:PRINT " to print pattern or ";
    183F 04B6      COLOR 15:PRINT "E";:COLOR 7:PRINT " to exit to print menu";
    1867 04B6      PRINT " or ";:COLOR 15:PRINT "S";:COLOR 7:PRINT " to use notepad";
    189C 04B6
    189C 04B6      'set screen to view menu just created and exit
    189C 04B6
30 189C 04B6      SCREEN 0,0,0,0
    18B1 04B6      RETURN
    18B5 04B6
    18B5 04B6      DISPMENU:
    18BA 04B6      IF MENUZ = 10 OR MENUZ = 11 THEN RETURN
    18DE 04B6      LOCATE (MENUZ MOD 61*2+7,(INT(MENUZ/61)*28+2)-2*INT(MENUZ/12)
35 193B 04B6      PRINT MENU$(MENUZ,0)
    1956 04B6      LOCATE (MENUZ MOD 61*2+7,MENU(MENUZ,4)
    19EB 04B6      PRINT USING MENU$(MENUZ,1);MENU(MENUZ,0);
    19FB 04B6      RETURN
    19FF 04B6      REM $PAGE

```

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Reagent Jet Printer
10 Pattern Printing

PAGE
09-17
08:45

IBM Personal Computer BASIC Compiler V2

Offset	Data	Source Line
196F	04B6	***** DATA USED BY THIS MODULE *****
198F	04B6	
15 198F	04B6	AFRDATA:
19C4	04B6	DATA *Dot Frequency Hz,"00,000",10000.1,1,16
19C6	04B6	DATA *Amplitude V,"000",150.0,1,19
19C8	04B6	DATA *Stroke Delay uS,"00,000.0",5999.5,.5..5,16
19CA	04B6	DATA *Pulse Width ", "000",999,0,1,19
19CC	04B6	DATA *Rise Time ", "000",999,0,1,19
20 19CE	04B6	DATA *Fall Time ", "000",999,0,1,19
19D0	04B6	DATA *Grid Size in","0.000",.005..005..005,45
19D2	04B6	DATA *Repeat Count ", "00",99,0,1,47
19D4	04B6	DATA *X Axis Offset in","0.000",2,0,.005,45
19D6	04B6	DATA *Y Axis Offset in","0.000",2,0,.005,45
19D8	04B6	DATA **,",",0,0,0,0
25 19DA	04B6	DATA **,",",0,0,0,0
19DC	04B6	DATA *Row to Print ", "00",99,1,1,74
19DE	04B6	DATA *Column to Print ", "00",99,1,1,74
19E0	04B6	DATA *Row Spacing in","0.000",3,0,.005,72
19E2	04B6	DATA *Column Spacing in","0.000",3,0,.005,72
19E4	04B6	DATA **,",",0,0,0,0
30 19E6	04B6	DATA **,",",0,0,0,0
19E8	04B6	
19E8	04B6	TABLE:
19ED	04B6	DATA 3,1,218
19EF	04B6	DATA 3,28,210
35 19F1	04B6	DATA 3,54,210
19F3	04B6	DATA 3,80,191
19F5	04B6	DATA 5,1,198
19F7	04B6	DATA 5,28,206
19F9	04B6	DATA 5,54,206
19FB	04B6	DATA 5,80,181
40 19FD	04B6	DATA 18,1,192
19FF	04B6	DATA 18,28,208
1A01	04B6	DATA 18,54,208
1A03	04B6	DATA 18,80,217
1A05	04B6	
1A05	04B6	END SUB
45 1A0C	04B6	
1A0C	04B6	
2069	04B6	

50426 Bytes Available
44716 Bytes Free

50

0 Warning Error(s)
0 Severe Error(s)

55

Reagent Jet Printer
Reagent Filing

PAGE 1
07-09-86
15:04:35

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0030 0006 REM $TITLE: 'Reagent Jet Printer' $SUBTITLE: 'Reagent Filing'
      0030 0006 MODULE - 'REAFILE' File Handling for reagents
      0030 0006
      0030 0006 AUTHOR - N. A. Enevold
10     0030 0006
      0030 0006 COPYRIGHT (C) 1985 ABBOTT LABORATORIES
      0030 0006
      0030 0006 REVISION - 1.1 03-07-86 NAE Added notes and description
      0030 0006 1.0 02-14-86 NAE Creation of initial code
15     0030 0006
      0030 0006 SYSTEM - This code can only be compiled by the BASCOM
      0030 0006 COMPILER, it will not run under the INTERPRETER!!
      0030 0006
      0030 0006 DESCRIPTION:
20     0030 0006 This module allow file handling for reagents. When inv
      oked, it displays
      0030 0006 the current contents of the reagent directory in 4 colu
      ans of 20 entries
      0030 0006 each. The reagent which is currently selected for prin
25     0030 0006 ting is marked by
      0030 0006 an asterisk to the left of the reagent name. After the
      directory is listed
      0030 0006 the user is presented with 5 menu choices. The left an
      d right arrows are
30     0030 0006 used to highlight menu items and the enter key is used
      to invoke action.
      0030 0006 The menu choices and their actions are:
      0030 0006
      0030 0006 DELETE - Remove a reagent file from the directo
35     0030 0006 ry
      0030 0006 COPY - Copy a reagent file to a new reagent n
      ame, saving the old reagent
      0030 0006 RENAME - Change the name of the reagent without
      changing the reagent itself
40     0030 0006 SELECT - Select a reagent for printing
      0030 0006 EXIT - Return to the main menu
      0030 0006
      0030 0006 DATA DICTIONARY
      0030 0006 TYPE% Which type of valid key was pushed
45     0030 0006 MENU% Which menu item is being pointer to (0-4)
      0030 0006 DIFF% Distance to move MENU% at left or right arro
      w
      0030 0006 FLAG% Error type 0-4
      0030 0006 POINTER% Position of REANAMES in directory list
50     0030 0006 REANUM% Number of reagent names in directory
      list
      0030 0006 TEMP% Storage for integers during reagent copy
      0030 0006 AS% Misc. input string
      0030 0006 FUNCT$ Printed at bottom of screen during prompt fo
55     r reagent name
      0030 0006 REANAMES Reagent name currently being worked on
      0030 0006 SELNAME$ Reagent name currently selected for printing
      0030 0006 FILE$ Filename of reagent data file
      0030 0006 SFILE$ Filename for source reagent data file used d

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5 Reagent Jet Printer PAGE 2
 Reagent Filing 07-09-86
 15:04:35

Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
10	0030 0006	uring copy	
	0030 0006	DFILES\$ Filename for destination reagent data file u	
	0030 0006	ses during copy	
	0030 0006	NEWNAME\$ New reagent name for COPY and RENAME	
15	0030 0006	TEMP\$ Reagent names are held here as the directory	
	0030 0006	is being re-written	
	0030 0006	NEWFILES\$ Destination filename used while copying reagent data files	
	0030 0006	MESSAGE\$ A message printed at the bottom of the screen	
20	0030 0006	MENU\$(4,1) Array of strings containing the short and long menu names	
	0030 0006	ERRMSG\$ Message printed when any error occurs	
	0030 0006	ERR\$ Appended to ERRMSG\$ to indicate nature of error	
25	0030 0006	REM \$PAGE	

30 Reagent Jet Printer PAGE 3
 Reagent Filing 07-09-86
 15:04:35

Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
	0030 0006	SUB REAGENT.FILE STATIC	
35	0047 0006	GOSUB INITIALIZE	
	0040 0006	TYPEZ = 0	
	0054 0008	WHILE TYPEZ <> 3	
	005F 0008	A\$ = ""	
40	0069 000C	WHILE A\$ = ""	
	0076 000C	A\$ = INKEY\$	
	0082 000C	WEND	
	0085 000C	IF A\$ = CHR\$(0) + CHR\$(75) THEN TYPEZ = 1:	
	00AA 000C	'left arrow	
45	00AA 000C	IF A\$ = CHR\$(0) + CHR\$(77) THEN TYPEZ = 2:	
	00CF 000C	'right arrow	
	00CF 000C	IF A\$ = CHR\$(13) THEN TYPEZ = 3:	
	00E9 000C	'<cr> to execute selection	
50	00E9 000C	ON TYPEZ GOSUB T1, T2, T3	
	00F8 000C	WEND	
	00FC 000C	EXIT SUB	
55	0100 000C	REM \$PAGE	

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Reagent Jet Printer
 Reagent Filing

PAGE 4
 07-09-86
 15:04:35

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

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0100 000C ***** SUB-ROUTINES FOR THIS MODULE *****

0100 000C

0100 000C T1: 'left arrow

0105 000C TYPE1 = 0

010C 000C IF MENUZ = 0 THEN RETURN

011B 000E DIFF1 = -1

0122 0010 GOSUB NEW.MENU

012B 0010 RETURN

30

012C 0010

012C 0010 T2: 'right arrow

0131 0010 TYPE2 = 0

013B 0010 IF MENUZ = 4 THEN RETURN

0147 0010 DIFF2 = 1

014E 0010 GOSUB NEW.MENU

35

0154 0010 RETURN

015B 0010

015B 0010 T3: '<cr> (execute selected menu item)

015D 0010 LOCATE 25,1:PRINT SPACE\$(79);

017A 0010 ON MENUZ + 1 GOSUB T3A, T3B, T3C, T3D, T3E

40

018F 0010 GOSUB MENU.ON

0195 0010 RETURN

0199 0010

0199 0010 REM \$PAGE

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Reagent Jet Printer
Reagent Filing

PAGE 5
07-09-86
15:04:35

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0199 0010 T3A:      'delete reagent
      019E 0010      TYPE% = 0
      01A5 0010      FUNCT$ = "Delete"
      01AF 0014      GOSUB GET.SOURCE
10     01B5 0014      IF LEN(REANAME$) = 0 THEN RETURN
      01C7 0018      IF REANAME$ = SELNAME$ THEN FLAG% = 4:GOSUB SHOW.ERROR:
      RETURN
      01E7 001E      GOSUB SEARCH
      01ED 001E      IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
15     0209 0020
      0209 0020      MESSAGE$ = "Deleting " + REANAME$ + "      Please Wait..
      .
      0220 0024      GOSUB MESSAGE.ON
      0226 0024
20     0226 0024      'rewrite directory deleting REANAME$ as indicat
      ed by POINTER%
      0226 0024      KILL "READIR.OLD"
      022D 0024      NAME "READIR.RJP" AS "READIR.OLD"
      0237 0024      OPEN "READIR.OLD" FOR INPUT AS #1
25     0248 0024      OPEN "READIR.RJP" FOR OUTPUT AS #2
      025A 0024
      025A 0024      INPUT #1, REANUM%
      026C 0026      REANUM% = REANUM% - 1
      0275 0026      WRITE #2,REANUM%
30     0286 0026
      0286 0026      IF REANUM% = 0 THEN GOTO DIR.DONE
      0295 0026      FOR I% = 1 TO REANUM% + 1
      02A4 0028          INPUT #1,REANAME$
      02B6 0028          IF I% <> POINTER% THEN PRINT #2,REANAME$
35     02D3 002A      NEXT I%
      02E5 002A
      02E5 002A      DIR.DONE:
      02EA 002A          CLOSE #1:CLOSE #2
      02FB 002A
40     02FB 002A      'remove data file
      02FB 002A      FILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER%))-1) +
      "REA.RJP"
      031C 002E      KILL FILE$
      0323 002E
45     0323 002E      'rename remaining data files to maintain linked
      list to directory
      0323 002E      WHILE (REANUM% + 1) > POINTER%
      0333 002E          SFILE$ = RIGHT$(STR$(POINTER%+1),LEN(STR$(POINT
      ER%+1))-1) + "REA.RJP"
50     0359 0032      DFILE$ = RIGHT$(STR$(POINTER%),LEN(STR$(POINTER
      %))-1) + "REA.RJP"
      037D 0036      NAME SFILE$ AS DFILE$
      0387 0036      POINTER% = POINTER% + 1
      0390 0036      WEND
55     0393 0036
      0393 0036      GOSUB MESSAGE.OFF
      0399 0036      REANAME$ = SELNAME$
      03A3 0036      GOSUB T3DA
      03A9 0036      GOSUB DISP.DIR

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Reagent Jet Printer
Reagent Filing

PAGE 6
07-09-86
15:04:35

Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
03AF	0036	RETURN	
03B3	0036		
03B3	0036	REM \$PAGE	

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Reagent Jet Printer
Reagent Filing

PAGE 7
07-09-86
15:04:35

IBM Personal Computer BASIC Compiler V2.00

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Offset  Data  Source Line
03B3  0036  T38:  'copy reagent
03B8  0036      TYPEZ = 0
03BF  0036      IF REANUMZ = 80 THEN FLAGZ = 3:GOSUB SHOW.ERROR:RETURN
03DB  0036      FUNCT$ = "Copy"
03E5  0036      GOSUB GET.SOURCE
03EB  0036      IF LEN(REANAME$) = 0 THEN RETURN
03FD  0036      GOSUB SEARCH
0403  0036      IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
041F  0036
041F  0036      GOSUB GET.NEW.NAME
0425  0036      IF LEN(NEWNAME$) = 0 THEN RETURN
0437  003A      IF LEN(NEWNAME$) > 15 THEN FLAGZ = 2:GOSUB SHOW.ERROR:R
          ETURN
0457  003A
0457  003A      MESSAGE$ = "Copying " + REANAME$ + " to " + NEWNAME$ +
          " Please wait.."
047C  003A      GOSUB MESSAGE.ON
0482  003A
0482  003A      'add new name at end of directory
0482  003A      KILL "READIR.OLD"
0489  003A      NAME "READIR.RJP" AS "READIR.OLD"
0493  003A      OPEN "READIR.OLD" FOR INPUT AS #1
04A4  003A      OPEN "READIR.RJP" FOR OUTPUT AS #2
04B6  003A
04B6  003A      INPUT #1, REANUMZ
04CB  003A      REANUMZ = REANUMZ + 1
04D1  003A      WRITE #2,REANUMZ
04E2  003A
04E2  003A      FOR IZ = 1 TO REANUMZ - 1
04F1  003C          INPUT #1,TEMP$
0503  0040          PRINT #2,TEMP$
0513  0040      NEXT IZ
0525  0040      PRINT #2,NEWNAME$
0535  0040
0535  0040      CLOSE #1:CLOSE #2
0543  0040
0543  0040      'create copy of data file
0543  0040      FILE$ = RIGHT$(STR$(POINTERZ),LEN(STR$(POINTERZ))-1) +
          "REA.RJP"
0567  0040      NEWFILE$ = RIGHT$(STR$(REANUMZ),LEN(STR$(REANUMZ))-1) +
          "REA.RJP"
058B  0044
058B  0044      OPEN FILE$ FOR INPUT AS #1
059C  0044      OPEN NEWFILE$ FOR OUTPUT AS #2
05AE  0044
05AE  0044      INPUT #1,TEMP
05C0  0048      WRITE #2,TEMP: 'frequency
05D0  0048      INPUT #1,TEMP
05E2  0048      WRITE #2,TEMP: 'pulse width
05F2  0048      INPUT #1,TEMP
0604  0048      WRITE #2,TEMP: 'strobe delay
0614  0048      INPUT #1,TEMP
0626  0048      WRITE #2,TEMP: 'nozzle
0636  0048

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Reagent Jet Printer
Reagent Filing

PAGE 8
07-09-86
15:04:35

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

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```
0636 0048 INPUT #1,TEMP$
0648 004E PRINT #2,TEMP$: 'concentration
0658 0048 INPUT #1,TEMP$
066A 0048 PRINT #2,TEMP$: 'density
067A 0048 INPUT #1,TEMP$
068C 0048 PRINT #2,TEMP$: 'viscosity
069C 0048
069C 0048 CLOSE #1:CLOSE #2
```

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```
06AA 0048 GOSUB MESSAGE.OFF
06B0 0048 GOSUB DISP.DIR
06B6 0048 RETURN
06BA 0048
06BA 0048 REM $PAGE
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Reagent Jet Printer
Reagent Filing

PAGE 9
07-09-86
15:04:35

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

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06BA 0048 JJC: 'rename reagent
06BF 0048 TYPE% = 0
06C6 0048 FUNCT$ = "Rename"
06D0 0048 GOSUB GET.SOURCE
06D6 0048 IF LEN(RENAME$) = 0 THEN RETURN
06E8 0048 GOSUB SEARCH
06EE 0048 IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
070A 0048
070A 0048 GOSUB GET.NEW.NAME
0710 0048 IF LEN(NEWNAME$) = 0 THEN RETURN
0722 0048 IF LEN(NEWNAME$) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
      ETURN
0742 0048 IF NEWNAME$ = RENAME$ THEN RETURN
0755 0048 MESSAGE$ = "Renaming " + RENAME$ + " to " + NEWNAME$ +
      " Please wait.."
077A 0048 GOSUB MESSAGE.ON
0780 0048
0790 0048 'renaming reagent name in directory
0780 0048 KILL "READIR.OLD"
0787 0048 NAME "READIR.RJP" AS "READIR.OLD"
0791 0048 OPEN "READIR.OLD" FOR INPUT AS #1
07A2 0048 OPEN "READIR.RJP" FOR OUTPUT AS #2
07B4 0048
07B4 0048 INPUT #1, REANUM%
07C6 0048 WRITE #2,REANUM%
07D7 0048
07D7 0048 FOR I% = 1 TO REANUM%
07E4 004A INPUT #1,TEMP$
07F6 004A IF I% <> POINTER% THEN PRINT #2,TEMP$
0813 004A IF I% = POINTER% THEN PRINT #2,NEWNAME$
0830 004A NEXT I%
0842 004A
0842 004A CLOSE #1:CLOSE #2
0850 004A
0850 004A GOSUB MESSAGE.OFF
0856 004A IF RENAME$ = SELNAME$ THEN RENAME$ = NEWNAME$:GOSUB T
      JDA
0875 004A GOSUB DISP.DIR
087B 004A RETURN
087F 004A
087F 004A REM $PAGE

```

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Reagent Jet Printer
Reagent Filing

PAGE 10
07-09-86
15:04:35

Offset Data Source Line IEM Personal Computer BASIC Compiler V2.00

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067F 004A T3D: 'select reagent for printing

0684 004A TYPEZ = 0

068B 004A FUNCT\$ = 'Select'

0695 004A GOSUB GET.SOURCE

20

069B 004A IF LEN(REANAME\$) = 0 THEN RETURN

06A0 004A IF REANAME\$ = SELNAME\$ THEN RETURN

06C0 004A GOSUB T3DA

06C6 004A GOSUB DISP.DIR

06CC 004A RETURN

25

08D0 004A

08D0 004A T3DA:

08D5 004A GOSUB SEARCH

08D6 004A IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN

08F7 004A

30

08F7 004A MESSAGE\$ = "Selecting " + REANAME\$ + " Please Wait.

090E 004A

090E 004A GOSUB MESSAGE.ON

0914 004A

0914 004A 'change entrys in reagent default file READEF.R

35

0914 004A

0914 004A JP

0926 004A OPEN "READEF.RJP" FOR OUTPUT AS #1

0926 004A FILE\$ = RIGHT\$(STR\$(POINTERZ),LEN(STR\$(POINTERZ))-1) +

"REA.RJP"

094A 004A

40

094A 004A PRINT #1,FILE\$

095A 004A PRINT #1,REANAME\$

096A 004A

096A 004A CLOSE #1

0971 004A GOSUB MESSAGE.OFF

45

0977 004A RETURN

097B 004A

097B 004A T3E: 'exit reagent filing

0980 004A RETURN

0984 004A

50

0984 004A REM \$PAGE

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Reagent Jet Printer
Reagent Filing

PAGE 11
07-09-86
15:04:35

Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
5	0984 004A	SEARCH:	
	0989 004A	POINTERZ = 0	
	0990 004A	OPEN "READIR.RJP" FOR INPUT AS #1	
	09A1 004A	INPUT #1,REANUMZ: ' get number of reagents in direc	
10		tory	
	09B3 004A	IF REANUMZ = 0 THEN CLOSE #1:RETURN	
	09C9 004A	TEMP\$ = ""	
	09D3 004A	WHILE (POINTERZ < REANUMZ) AND (REANAME\$ <> TEMP\$)	
	09FE 004A	LINE INPUT #1,TEMP\$	
15	0A06 004A	POINTERZ = POINTERZ + 1	
	0A11 004A	WEND	
	0A14 004A	IF REANAME\$ <> TEMP\$ THEN POINTERZ = 0	
	0A2A 004A	CLOSE #1	
	0A31 004A	RETURN	
20	0A35 004A		
	0A35 004A	GET.SOURCE:	
	0A3A 004A	LOCATE 25,1:COLOR 15,0:PRINT "Enter Reagent Name to "FU	
		NCT\$ " ";	
	0A6C 004A	LINE INPUT;"",REANAME\$	
25	0A7A 004A	LOCATE 25,1:PRINT SPACE\$(79);	
	0A97 004A	RETURN	
	0A9B 004A		
	0A9B 004A	GET.NEW.NAME:	
	0AA0 004A	LOCATE 25,1:COLOR 15,0:PRINT "Enter New Reagent Name ";	
30	0AC6 004A	LINE INPUT:" ",NEWNAME\$	
	0AD4 004A	LOCATE 25,1:PRINT SPACE\$(79);	
	0AF1 004A	RETURN	
	0AF5 004A		
	0AF5 004A	DISP.DIR: 'display reagent directory in 4 columns of 20 r	
35		ows	
	0AFA 004A	'read selected reagent into SELNAME\$	
	0AFA 004A	OPEN "READEF.RJP" FOR INPUT AS #1	
	0B08 004A	INPUT #1,SELNAME\$: 'read and discard data file nam	
		e	
40	0B1D 004A	INPUT #1,SELNAME\$: 'read and save reagent name	
	0B2F 004A	CLOSE #1	
	0B36 004A		
	0B36 004A	OPEN "READIR.RJP" FOR INPUT AS #1	
	0B47 004A	INPUT #1,REANUMZ: ' read number of reagents	
45	0B5F 004A	MESSAGE\$ = "Reading Reagent Directory Please Wait"	
	0B63 004A	GOSUB MESSAGE.ON	
	0B69 004A	FLAGZ = 0	
	0B70 004A	TEMPZ = REANUMZ - 1:IF REANUMZ < 80 THEN TEMPZ = REANUM	
		1	
50	0B8B 004C	FOR IZ = 0 TO TEMPZ	
	0B97 004E	LOCATE (IZ MOD 20)+1,(INT(IZ/20)*20)+1	
	0BCA 004E	PRINT SPACE\$(18);	
	0BDA 004E	WAIT IZ	
	0BEC 004E		
55	0BEC 004E	FOR IZ = 0 TO REANUMZ - 1	
	0BFA 0050	INPUT #1,REANAME\$	
	0C0C 0050	LOCATE (IZ MOD 20)+1,(INT(IZ/20)*20)+3	
	0C3F 0050	PRINT REANAME\$;	
	0C4C 0050	IF REANAME\$ = SELNAME\$ THEN LOCATE (IZ MOD 20)+	

Reagent Jet Printer
Reagent Filing

PAGE 12
07-09-86
15:04:35

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5
      1, (INT (I2/20)+20)+1:PRINT "*";
      OC9E 0050      NEXT I2
      OCB0 0050      CLOSE #1
      OCB7 0050      GOSUB MESSAGE.OFF
10      OCB0 0050      RETURN
      OCC1 0050
      OCC1 0050      INITIALIZE:
      OCC6 0050      DIM MENU$(4,1)
      OCC7 0078      MENU$(0,0) = "Delete"
15      OCBF 0078      MENU$(0,1) = "Remove a reagent file from the directory"
      OCFA 0078      MENU$(1,0) = "Copy"
      OD15 0078      MENU$(1,1) = "Copy a reagent file to a new reagent name"
      .
      OD2E 0078      MENU$(2,0) = "Rename"
20      OD4B 0078      MENU$(2,1) = "Rename a reagent file in the directory"
      OD69 0078      MENU$(3,0) = "Select"
      OD84 0078      MENU$(3,1) = "Select a reagent file to be printed"
      ODA0 0078      MENU$(4,0) = "Exit"
      ODBB 0078      MENU$(4,1) = "Return to the main menu"
25      ODD7 0078
      ODD7 0078      COLOR 9,0:CLS
      ODEA 0078      LOCATE 21,1
      ODF7 0078      FOR I2 = 1 TO 80
      ODFE 0078          PRINT "D";
30      OE0B 0078      NEXT I2
      OE1B 0078
      OE1B 0078      FOR MENUZ = 0 TO 4
      OE21 0078          GOSUB MENU.OFF
      OE27 0078      NEXT MENUZ
35      OE37 0078
      OE37 0078      GOSUB DISP.DIR
      OE3D 0078      IF FLAG% > 0 THEN GOSUB SHOW.ERROR
      OE4E 0078      MENUZ = 4
      OE55 0078      GOSUB MENU.ON
40      OE5B 0078
      OE5B 0078      RETURN
      OE5F 0078
      OE5F 0078      NEW.MENU:
      OE64 0078          GOSUB MENU.OFF
      OE6A 0078          MENUZ = MENUZ + DIFFZ
45      OE76 0078          GOSUB MENU.ON
      OE7C 0078          RETURN
      OE80 0078
      OE80 0078      MENU.ON:
50      OE85 0078          LOCATE 22, (MENUZ*10)+18
      OE9C 0078          COLOR 0,7
      OEAB 0078          PRINT MENU$(MENUZ,0);
      OEC6 0078          LOCATE 25,40-LEN(MENU$(MENUZ,1))/2
      OEFA 0078          COLOR 7,0
55      OF06 0078          PRINT MENU$(MENUZ,1);
      OF25 0078          RETURN
      OF29 0078
      OF29 0078      MENU.OFF:
      OF2E 0078          LOCATE 22, (MENUZ*10)+18

```

Reagent Jet Printer
Reagent Filing

PAGE 13
07-09-86
15:04:35

Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
5	0F45 0078	COLOR 14,0	
	0F51 0078	PRINT MENU\$(MENUZ,0);	
	0F6F 0078	LOCATE 25,40-LEN(MENU\$(MENUZ,1))/2	
	0FA3 0078	PRINT SPACE\$(LEN(MENU\$(MENUZ,1)));	
10	0FCB 0078	RETURN	
	0FCC 0078		
	0FCC 0078	SHOW.ERROR:	
	0FD1 0078	ON FLAG% GOSUB ER1, ER2, ER3, ER4	
	0FE2 0078	ERRMSG\$ = ERR\$ + " Strike any key.."	
15	0FF2 0080	LOCATE 24,40-LEN(ERRMSG\$)/2	
	1014 0080	COLOR 13,0	
	1020 0080	PRINT ERRMSG\$;	
	102D 0080	A\$ = ""	
	1037 0080	WHILE A\$ = ""	
20	1046 0060	A\$ = INKEY\$	
	1050 0080	WEND	
	1053 0080	GOSUB MESSAGE.OFF	
	1059 0080	RETURN	
	105D 0080		
25	105D 0080	ER1:	
	1062 0080	ERR\$ = REANAME\$ + " Not Found in the Directory"	
	1072 0080	RETURN	
	1076 0080		
	1076 0080	ER2:	
30	107B 0080	ERR\$ = "Reagent Name is too Long (15 characters max.)"	
	1085 0080	RETURN	
	1089 0080		
	1089 0080	ER3:	
	108E 0080	ERR\$ = "Directory is Full (60 reagents max.)"	
35	1098 0080	RETURN	
	109C 0080		
	109C 0080	ER4:	
	10A1 0080	ERR\$ = "Cannot Modify SELECTd reagent Name"	
	10AB 0080	RETURN	
40	10AF 0080		
	10AF 0080	MESSAGE.ON:	
	10B4 0080	LOCATE 24,38 - LEN(MESSAGE\$) / 2:COLOR 11,0:PRINT MESSA	
		GE\$;	
	10EF 0080	RETURN	
45	10F3 0080		
	10F3 0080		
	10F3 0080	MESSAGE.OFF:	
	10F8 0080	LOCATE 24,1:COLOR 15,0:PRINT SPACE\$(79);	
	1121 0080	RETURN	
50	1125 0080		
	1125 0080	END SUB	
	112C 0080		
	16C9 0080		

55 50426 Bytes Available
45718 Bytes Free

0 Warning Error(s)
0 Severe Error(s)

Reagent Jet Printer
Pattern Filing

PAGE 1
07-09-86
15:11:46

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0030 0006 REM $TITLE: 'Reagent Jet Printer' $SUBTITLE: 'Pattern Filing'
      0030 0006 'MODULE - 'PATFILE' File Handling for patterns
      0030 0006 '
      0030 0006 'AUTHOR - N. A. Enevold
10     0030 0006 '
      0030 0006 'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
      0030 0006 '
      0030 0006 'REVISION - 1.0 02-12-86 MAE Creation of initial code
      0030 0006 '
15     0030 0006 'SYSTEM - This code can only be compiled by the BASCOM
      0030 0006 '          COMPILER, it will not run under the INTERPRETER!!
      0030 0006 '
      0030 0006 'DESCRIPTION:
      0030 0006 '          This module allow file handling for patterns. When inv
20     0030 0006 '          oked, it displays
      0030 0006 '          the current contents of the pattern directory in 4 colu
      0030 0006 '          ens of 20 entries
      0030 0006 '          each. The pattern which is currently selected for prin
      0030 0006 '          ting is marked by
25     0030 0006 '          an asterisk to the left of the pattern name. After the
      0030 0006 '          directory is listed
      0030 0006 '          the user is presented with 5 menu choices. The left an
      0030 0006 '          d right arrows are
      0030 0006 '          used to highlight menu items and the enter key is used
30     0030 0006 '          to invoke action.
      0030 0006 '          The menu choices and their actions are:
      0030 0006 '
      0030 0006 '          DELETE - Remove a pattern file from the directo
      0030 0006 '          ry
35     0030 0006 '          COPY - Copy a pattern file to a new pattern n
      0030 0006 '          ame, saving the old pattern
      0030 0006 '          RENAME - Change the name of the pattern without
      0030 0006 '          changing the pattern itself
      0030 0006 '          SELECT - Select a pattern for printing
40     0030 0006 '          EXIT - Return to the main menu
      0030 0006 '
      0030 0006 'DATA DICTIONARY
      0030 0006 '          TYPEZ Which type of valid key was pushed
      0030 0006 '          MENUZ Which menu item is being pointer to (0-4)
45     0030 0006 '          DIFFZ Distance to move MENUZ at left or right arro
      0030 0006 '
      0030 0006 '          FLASZ Error type 0-4
      0030 0006 '          POINTERZ Position of PATNAME$ in directory list
      0030 0006 '          PATNUMZ Number of pattern names in directory
50     0030 0006 '          list
      0030 0006 '          ELNUMZ Number of elements in a pattern file
      0030 0006 '          TEMPZ Storage for integers during pattern copy
      0030 0006 '          IZ Counter used during pattern copy
      0030 0006 '          JZ Counter used during pattern copy
55     0030 0006 '          AS Misc. input string
      0030 0006 '          FUNCT$ Printed at bottom of screen during prompt fo
      0030 0006 '          r pattern name
      0030 0006 '          PATNAME$ Pattern name currently being worked on
      0030 0006 '          SELNAME$ Pattern name currently selected for printing

```

Reagent Jet Printer
Pattern Filing

PAGE 2
07-09-86
15:11:46

Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
0030	0006	FILE\$	Filename of pattern data file
0030	0006	SFILE\$	Filename for source pattern data file used during copy
0030	0006	DFILE\$	Filename for destination pattern data file used during copy
0030	0006	NEWNAME\$	New pattern name for COPY and RENAME
0030	0006	TEMP\$	Pattern names are held here as the directory is being re-written
0030	0006	NEWFILE\$	Destination filename used while copying pattern data files
0030	0006	MESSAGE\$	A message printed at the bottom of the screen
0030	0006	MENU\$(4,1)	Array of strings containing the short and long menu names
0030	0006	ERRMSG\$	Message printed when any error occurs
0030	0006	ERR\$	Appended to ERRMSG\$ to indicate nature of error
0030	0006	TEMP	Storage of real variables while copying pattern data files
0030	0006	REM \$PAGE	

30

Reagent Jet Printer
Pattern Filing

PAGE 3
07-09-86
15:11:46

Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
0030	0006	SUB PATTERN.FILE STATIC	
0047	0006	GOSUB INITIALIZE	
0040	0006	TYPEZ = 0	
0054	0008	WHILE TYPEZ <> 3	
005F	0008	A\$ = ""	
0069	000C	WHILE A\$ = ""	
0076	000C	A\$ = INKEY\$	
0082	000C	WEND	
0085	000C	IF A\$ = CHR\$(0) + CHR\$(75) THEN TYPEZ = 1:	
00AA	000C	'left arrow IF A\$ = CHR\$(0) + CHR\$(77) THEN TYPEZ = 2:	
00CF	000C	'right arrow IF A\$ = CHR\$(13) THEN TYPEZ = 3:	
00E9	000C	'<cr> to execute selection	
00E9	000C	ON TYPEZ GOSUB T1, T2, T3	
00FB	000C	WEND	
00FC	000C	EXIT SUB	
0100	000C	REM \$PAGE	

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Reagent Jet Printer
Pattern Filing

PAGE 4
07-09-86
15:11:46

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Offset Data Source Line IEM Personal Computer BASIC Compiler V2.00

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0100 000C ***** SUB-ROUTINES FOR THIS MODULE *****

0100 000C

0100 000C T1: 'left arrow

0105 000C TYPEZ = 0

010C 000C IF MENUZ = 0 THEN RETURN

011B 000E DIFFZ = -1

0122 0010 GOSUB NEW.MENU

012B 0010 RETURN

30

012C 0010

012C 0010 T2: 'right arrow

0131 0010 TYPEZ = 0

013B 0010 IF MENUZ = 4 THEN RETURN

0147 0010 DIFFZ = 1

35

014E 0010 GOSUB NEW.MENU

0154 0010 RETURN

015B 0010

015B 0010 T3: '<cr> (execute selected menu item)

015D 0010 LOCATE 25,1:PRINT SPACE\$(79);

40

017A 0010 ON MENUZ + 1 GOSUB T3A, T3B, T3C, T3D, T3E

018F 0010 GOSUB MENU.ON

0195 0010 RETURN

0199 0010

0199 0010 REM \$PAGE

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Reagent Jet Printer
Pattern Filing

PAGE 5
07-09-86
15:11:46

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0199 0010 T3A:      delete pattern
      019E 0010      TYPEZ = 0
      01A5 0010      FUNCT$ = "Delete"
      01AF 0014      GOSUB GET.SOURCE
10     01B5 0014      IF LEN(PATNAME$) = 0 THEN RETURN
      01C7 0018      IF PATNAME$ = SELNAME$ THEN FLAGZ = 4:GOSUB SHOW.ERROR:
      RETURN
      01E7 001E      GOSUB SEARCH
      01ED 001E      IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
15     0209 0020
      0209 0020      MESSAGE$ = "Deleting " + PATNAME$ + "      Please Wait..
      .
      0220 0024      GOSUB MESSAGE.ON
      0226 0024
20     0226 0024      'rewrite directory deleting PATNAME$ as indicat
      ed by POINTERZ
      0226 0024      KILL "PATDIR.OLD"
      022D 0024      NAME "PATDIR.RJP" AS "PATDIR.OLD"
      0237 0024      OPEN "PATDIR.OLD" FOR INPUT AS #1
25     024B 0024      OPEN "PATDIR.RJP" FOR OUTPUT AS #2
      025A 0024
      025A 0024      INPUT #1, PATNUMZ
      026C 0026      PATNUMZ = PATNUMZ - 1
      0275 0026      WRITE #2,PATNUMZ
30     0286 0026
      0286 0026      IF PATNUMZ = 0 THEN GOTO DIR.DONE
      0295 0026      FOR IZ = 1 TO PATNUMZ + 1
      02A4 0028          INPUT #1,PATNAME$
      02B6 0028          IF IZ <> POINTERZ THEN PRINT #2,PATNAME$
35     02D3 002A      NEXT IZ
      02E5 002A
      02E5 002A      DIR.DONE:
      02EA 002A          CLOSE #1:CLOSE #2
      02FB 002A
40     02FB 002A      'remove data file
      02FB 002A      FILES$ = RIGHT$(STR$(POINTERZ),LEN(STR$(POINTERZ))-1) +
      "PAT.RJP"
      031C 002E      KILL FILES
      0323 002E
45     0323 002E      'rename remaining data files to maintain linked
      list with directory
      0323 002E      WHILE (PATNUMZ + 1) > POINTERZ
      0333 002E          SFILES$ = RIGHT$(STR$(POINTERZ+1),LEN(STR$(POINT
      ERZ+1))-1) + "PAT.RJP"
      0359 0032          DFILES$ = RIGHT$(STR$(POINTERZ),LEN(STR$(POINTER
      Z))-1) + "PAT.RJP"
50     037D 0036          NAME SFILES$ AS DFILES$
      0387 0036          POINTERZ = POINTERZ + 1
      039C 0036      WEND
      0393 0036
55     0393 0036      GOSUB MESSAGE.OFF
      0399 0036      PATNAME$ = SELNAME$
      03A3 0036      GOSUB T3DA
      03A9 0036      GOSUB DISP.DIR

```

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Reagent Jet Printer
Pattern Filing

PAGE 6
07-09-86
15:11:46

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

30

03AF 0036 RETURN
03B3 0036
03B3 0036 REM \$PAGE

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Reagent Jet Printer
Pattern Filing

PAGE 7
07-09-86
15:11:46

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      03B3 0036 702: 'copy pattern
      03B6 0036      TYPEZ = 0
      03BF 0036      IF PATNUMZ = 80 THEN FLAGZ = 3:GOSUB SHOW.ERROR:RETURN
      03DE 0036      FUNCT$ = "Copy"
10     03E5 0036      GOSUB GET.SOURCE
      03EB 0036      IF LEN(PATNAME$) = 0 THEN RETURN
      03FD 0036      GOSUB SEARCH
      0403 0036      IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
      041F 0036
15     041F 0036      GOSUB GET.NEW.NAME
      0425 0036      IF LEN(NEWNAME$) = 0 THEN RETURN
      0437 0036      IF LEN(NEWNAME$) > 15 THEN FLAGZ = 2:GOSUB SHOW.ERROR:R
      ETURN

      0457 003A
20     0457 003A      MESSAGE$ = "Copying " + PATNAME$ + " to " + NEWNAME$ +
      " Please wait..."
      047C 003A      GOSUB MESSAGE.ON
      0482 003A
      0482 003A      'add NEWNAME$ at end of directory
25     0482 003A      KILL "PATDIR.OLD"
      0489 003A      NAME "PATDIR.RJP" AS "PATDIR.OLD"
      0493 003A      OPEN "PATDIR.OLD" FOR INPUT AS #1
      04A4 003A      OPEN "PATDIR.RJP" FOR OUTPUT AS #2
      04B6 003A
30     04B6 003A      INPUT #1, PATNUMZ
      04CB 003A      PATNUMZ = PATNUMZ + 1
      04D1 003A      WRITE #2,PATNUMZ
      04E2 003A
      04E2 003A      FOR IZ = 1 TO PATNUMZ - 1
35     04F1 003C          INPUT #1,TEMP$
      0503 0040          PRINT #2,TEMP$
      0513 0040      NEXT IZ
      0525 0040      PRINT #2,NEWNAME$
      0535 0040
40     0535 0040      CLOSE #1:CLOSE #2
      0543 0040
      0543 0040      'create copy of pattern data file
      0543 0040      FILE$ = RIGHT$(STR$(POINTERZ),LEN(STR$(POINTERZ))-1) +
      "PAT.RJP"
45     0567 0040      NEWFILE$ = RIGHT$(STR$(PATNUMZ),LEN(STR$(PATNUMZ))-1) +
      "PAT.RJP"
      058B 0044
      058B 0044      OPEN FILE$ FOR INPUT AS #1
      059C 0044      OPEN NEWFILE$ FOR OUTPUT AS #2
50     05AE 0044
      05AE 0044      INPUT #1,ELNUMZ
      05C0 0046      WRITE #2,ELNUMZ
      05D1 0046
      05D1 0046      FOR IZ = 1 TO 4
55     05DB 0046          INPUT #1,TEMP
      05EA 004A          WRITE #2,TEMP
      05FA 004A      NEXT IZ
      060A 004A
      060A 004A      FOR IZ = 1 TO ELNUMZ

```



Reagent Jet Printer
Fattern Filing

PAGE 8
07-09-86
15:11:46

	Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
5	0617	004C		FOR J% = 1 TO 6
	061E	004C		INPUT #1,TEMP%
	0630	004E		WRITE #2,TEMP%
	0641	004E		NEXT J%
10	0651	0050		NEXT I%
	0663	0050		
	0663	0050		CLOSE #1:CLOSE #2
	0671	0050		
	0671	0050		GOSUB MESSAGE.OFF
15	0677	0050		GOSUB DISP.DIR
	067D	0050		RETURN
	0681	0050		
	0681	0050	T3C:	'rename pattern
	0686	0050		TYPE% = 0
20	068D	0050		FUNCT% = "Rename"
	0697	0050		GOSUB GET.SOURCE
	069D	0050		IF LEN(PATNAME%) = 0 THEN RETURN
	06AF	0050		GOSUB SEARCH
	06B5	0050		IF POINTER% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
25	06D1	0050		
	06D1	0050		GOSUB GET.NEW.NAME
	06D7	0050		IF LEN(NEWNAME%) = 0 THEN RETURN
	06E9	0050		IF LEN(NEWNAME%) > 15 THEN FLAG% = 2:GOSUB SHOW.ERROR:R
			ETURN	
30	0709	0050		IF NEWNAME% = PATNAME% THEN RETURN
	071C	0050		
	071C	0050		MESSAGE% = "Renaming " + PATNAME% + " to " + NEWNAME% + " Please wait.."
	0741	0050		GOSUB MESSAGE.ON
35	0747	0050		
	0747	0050		'change pattern name in directory replacing PAT NAME% with NEWNAME%
	0747	0050		KILL "PATDIR.OLD"
	074E	0050		NAME "PATDIR.RJP" AS "PATDIR.OLD"
40	0756	0050		OPEN "PATDIR.OLD" FOR INPUT AS #1
	0769	0050		OPEN "PATDIR.RJP" FOR OUTPUT AS #2
	077B	0050		
	077B	0050		INPUT #1, PATNUM%
	078D	0050		WRITE #2,PATNUM%
45	079E	0050		
	079E	0050		FOR I% = 1 TO PATNUM%
	07AB	0052		INPUT #1,TEMP%
	07BD	0052		IF I% <> POINTER% THEN PRINT #2,TEMP%
	07DA	0052		IF I% = POINTER% THEN PRINT #2,NEWNAME%
50	07F7	0052		NEXT I%
	0809	0052		
	0809	0052		CLOSE #1:CLOSE #2
	0817	0052		
	0817	0052		GOSUB MESSAGE.OFF
55	081D	0052		
	081D	0052		'select new pattern name if necessary
	081D	0052		IF PATNAME% = SELNAME% THEN PATNAME% = NEWNAME%:GOSUB T
			3DA	
	083C	0052		GOSUB DISP.DIR

Reagent Jet Printer
Pattern Filing

PAGE 9
07-09-86
15:11:46

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

0842 0052 RETURN
0846 0052
0846 0052 REM \$PAGE

Reagent Jet Printer
Pattern Filing

PAGE 10
07-09-86
15:11:46

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

0846 0052 T3D: 'select pattern for printing
0848 0052 TYPEZ = 0
0852 0052 FUNCT\$ = 'Select'
085C 0052 GOSUB GET.SOURCE
0862 0052 IF LEN(PATNAME\$) = 0 THEN RETURN
0874 0052 IF PATNAME\$ = SELNAME\$ THEN RETURN
0887 0052 GOSUB T3DA
088D 0052 GOSUB DISP.DIR
0893 0052 RETURN
0897 0052
0897 0052 T3DA:
089C 0052 GOSUB SEARCH
08A2 0052 IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
08BE 0052
08BE 0052 MESSAGE\$ = 'Selecting ' + PATNAME\$ + ' Please Wait.
..
08D5 0052 GOSUB MESSAGE.ON
08DB 0052
08DB 0052 'change entrys in pattern default file PATDEF.R
JP
08DB 0052 OPEN "PATDEF.RJP" FOR OUTPUT AS #1
08ED 0052 FILE\$ = RIGHT\$(STR\$(POINTERZ),LEN(STR\$(POINTERZ))-1) +
"PAT.RJP"
0911 0052
0911 0052 PRINT #1,FILE\$
0921 0052 PRINT #1,PATNAME\$
0931 0052
0931 0052 CLOSE #1
0938 0052 GOSUB MESSAGE.OFF
093E 0052 RETURN
0942 0052
0942 0052 T3E: 'exit pattern filing
0947 0052 RETURN
094B 0052
094B 0052 REM \$PAGE

Reagent Jet Printer
Pattern Filing

PAGE 11
07-09-86
15:11:46

IBM Personal Computer BASIC Console V2.00

```

5      094B 0052 SEARCH:
      0950 0052     POINTERZ = 0
      0957 0052     OPEN "PATDIR.RJP" FOR INPUT AS #1
      0968 0052     INPUT #1,PATNUMZ: ' get number of patterns in direc
10      lory
      097A 0052     IF PATNUMZ = 0 THEN CLOSE #1:RETURN
      0990 0052     TEMP$ = ""
      099A 0052     WHILE (POINTERZ < PATNUMZ) AND (PATNAME$ <> TEMP$)
      09C2 0052         LINE INPUT #1,TEMP$
15      09CF 0052         POINTERZ = POINTERZ + 1
      09DB 0052     WEND
      09DB 0052     IF PATNAME$ <> TEMP$ THEN POINTERZ = 0
      09F1 0052     CLOSE #1
      09FB 0052     RETURN
20      09FC 0052
      09FC 0052 GET.SOURCE:
      0A01 0052     LOCATE 25,1:COLOR 15,0:PRINT "Enter Pattern Name to "FU
      NCT$ " ";
25      0A33 0052     LINE INPUT: "",PATNAME$
      0A41 0052     LOCATE 25,1:PRINT SPACES(79);
      0A5E 0052     RETURN
      0A62 0052
      0A62 0052 GET.NEW.NAME:
      0A67 0052     LOCATE 25,1:COLOR 15,0:PRINT "Enter New Pattern Name ";
30      0ABD 0052     LINE INPUT: "",NEWNAME$
      0A9B 0052     LOCATE 25,1:PRINT SPACES(79);
      0ABB 0052     RETURN
      0ABC 0052
35      0ABC 0052 DISP.DIR: 'display directory in 4 columns, 20 rows
      0AC1 0052     'read default pattern name into SELNAME$
      0AC1 0052     OPEN "PATDEF.RJP" FOR INPUT AS #1
      0AD2 0052     INPUT #1,SELNAME$: 'discard data file name
      0AE4 0052     INPUT #1,SELNAME$
      0AF6 0052     CLOSE #1
40      0AFD 0052
      0AFD 0052     OPEN "PATDIR.RJP" FOR INPUT AS #1
      0B0E 0052     INPUT #1,PATNUMZ: ' read number of patterns
      0B20 0052
45      0B20 0052     MESSAGE$ = "Reading Pattern Directory Please Wait"
      0B2A 0052     GOSUB MESSAGE.ON
      0B30 0052     FLAGZ = 0
      0B37 0052     TEMPZ = PATNUMZ - 1:IF PATNUMZ < 80 THEN TEMPZ = PATNUM
      Z
50      0B52 0052     FOR IZ = 0 TO TEMPZ
      0B5E 0054         LOCATE (IZ MOD 20)+1,(INT(IZ/20)*20)+1
      0B91 0054         PRINT SPACES(18);
      0BA1 0054     NEXT IZ
      0BB3 0054
      0BB3 0054     FOR IZ = 0 TO PATNUMZ - 1
55      0BC1 0056         INPUT #1,PATNAME$
      0BD3 0056         LOCATE (IZ MOD 20)+1,(INT(IZ/20)*20)+3
      0C06 0056         PRINT PATNAME$;
      0C13 0056         IF PATNAME$ = SELNAME$ THEN LOCATE (IZ MOD 20)+
1,(INT(IZ/20)*20)+1:PRINT "*";

```

Reagent Jet Printer
Pattern Filing

PAGE 12
07-09-86
15:11:46

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0C62 0056      NEXT I%
      0C77 0056      CLOSE #1
      0C7E 0056      GOSUB MESSAGE.OFF
      0C84 0056      RETURN
10     0C86 0056
      0C8E 0056      INITIALIZE:
      0C8D 0056      DIM MENU$(4,1)
      0C8E 007E      MENU$(0,0) = "Delete"
      0CA6 007E      MENU$(0,1) = "Remove a pattern file from the directory"
15     0CC1 007E      MENU$(1,0) = "Copy"
      0CDC 007E      MENU$(1,1) = "Copy a pattern file to a new pattern name

      0CF5 007E      MENU$(2,0) = "Rename"
      0D12 007E      MENU$(2,1) = "Rename a pattern file in the directory"
20     0D30 007E      MENU$(3,0) = "Select"
      0D4B 007E      MENU$(3,1) = "Select a pattern file to be printed"
      0D67 007E      MENU$(4,0) = "Exit"
      0D82 007E      MENU$(4,1) = "Return to the main menu"
      0D9E 007E

25     0D9E 007E      COLOR 9,0:CLS
      0DB1 007E      LOCATE 21,1
      0DBE 007E      FOR I% = 1 TO 80
      0DC5 007E          PRINT "D";
      0DD2 007E      NEXT I%

30     0DE2 007E
      0DE2 007E      FOR MENU% = 0 TO 4
      0DEB 007E          GOSUB MENU.OFF
      0DEE 007E      NEXT MENU%
      0DFE 007E

35     0DFE 007E      GOSUB DISP.DIR
      0E04 007E      IF FLAG% > 0 THEN GOSUB SHOW.ERROR
      0E15 007E      MENU% = 4
      0E1C 007E      GOSUB MENU.ON
      0E22 007E

40     0E22 007E      RETURN
      0E26 007E
      0E26 007E      NEW.MENU:
      0E2B 007E          GOSUB MENU.OFF
      0E31 007E          MENU% = MENU% + DIFF%
      0E3D 007E          GOSUB MENU.ON
45     0E43 007E      RETURN
      0E47 007E
      0E47 007E      MENU.ON:
      0E4C 007E          LOCATE 22,(MENU%*10)+18
      0E63 007E          COLOR 0,7
50     0E6F 007E          PRINT MENU$(MENU%,0);
      0EBD 007E          LOCATE 25,40-LEN(MENU$(MENU%,1))/2
      0EC1 007E          COLOR 7,0
      0ECD 007E          PRINT MENU$(MENU%,1);
      0EEC 007E      RETURN
55     0EF0 007E
      0EF0 007E      MENU.OFF:
      0EF5 007E          LOCATE 22,(MENU%*10)+18
      0F0C 007E          COLOR 14,0

```

Reagent Jet Printer
Pattern Filing

PAGE 13
07-09-86
15:11:46

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

5

```
0F18 007E      PRINT MENU$(MENUZ,0);
0F36 007E      LOCATE 25,40-LEN(MENU$(MENUZ,1))/2
0F6A 007E      PRINT SPACES$(LEN(MENU$(MENUZ,1)));
0F8F 007E      RETURN
```

10

```
0F93 007E      SHOW.ERROR:
0F93 007E      ON FLAG% GOSUB ER1, ER2, ER3, ER4
0FA9 007E      ERRMSG$ = ERR$ + "      Strike any key.."
0FB9 0086      LOCATE 24,40-LEN(ERRMSG$)/2
0FDB 0086      COLOR 13,0
0FE7 0086      PRINT ERRMSG$;
0FF4 0086      A$ = ""
OFFE 0086      WHILE A$ = ""
100D 0086          A$ = INKEY$
```

15

20

```
1017 0066      WEND
101A 0086      GOSUB MESSAGE.OFF
1020 0086      RETURN
```

25

```
1024 0086      ER1:
1029 0086          ERR$ = PATNAME$ + " Not Found in the Directory"
1039 0086          RETURN
103D 0086      ER2:
```

30

```
1042 0086          ERR$ = "Pattern Name is too Long (15 characters max.)"
104C 0086          RETURN
1050 0086      ER3:
```

35

```
1050 0086          ERR$ = "Directory is Full (80 patterns max.)"
105F 0086          RETURN
1063 0086      ER4:
```

40

```
1063 0086          ERR$ = "Cannot Modify SELECTd pattern Name"
1068 0086          RETURN
1072 0086      MESSAGE.ON:
1076 0086          LOCATE 24,38 - LEN(MESSAGE$) / 2:COLOR 11,0:PRINT MESSA
107B 0086          GE$;
1086 0086          RETURN
```

45

```
108A 0086      MESSAGE.OFF:
108A 0086          LOCATE 24,1:COLOR 15,0:PRINT SPACES$(79);
10BF 0086          RETURN
10EB 0086      END SUB
```

50

```
10EC 0086      END SUB
10F3 0086
168B 0086
```

55

50426 Bytes Available
45670 Bytes Free

0 Warning Error(s)
0 Severe Error(s)

Reagent Jet Printer
Main Line Code

PAGE 1
07-09-86
15:27:04

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

5

0030 0006 REM \$TITLE: 'Reagent Jet Printer' \$SUBTITLE: 'Main Line Code'

0030 0006

0030 0006 'MODULE - "MAIN"

0030 0006

10

0030 0006 'AUTHOR - W. A. Enevold

0030 0006

0030 0006 'COPYRIGHT (C) 1986 ABBOTT LABORATORIES

0030 0006

0030 0006 'REVISION - 1.1 02-19-86 NAE Add notes and revise TYPEZ resetin

15

0030 0006

0030 0006 ' - 1.0 02-14-86 NAE Creation of initial code

0030 0006

0030 0006 'SYSTEM - This code can only be compiled by the BASCOM

0030 0006

COMPILER, it will not run under the INTERPRETER!!

20

0030 0006

0030 0006 'DESCRIPTION

0030 0006

' This is the main controlling module for the Reagent Jet Printer.

0030 0006

' It displays a menu in table form that allows 6 functions to be

25

0030 0006

' selected. PATTERN DEFINITION allows the user to define patterns

0030 0006

' to be printed. PATTERN FILING lets the user delete, copy, rename

30

0030 0006

' and select patterns for printing. REAGENT CALIBRATION permits setting

0030 0006

' of operation parameters for different reagents. REAGENT FILING is

0030 0006

' the same as pattern filing. PRINTING PRINT prints the selected

35

0030 0006

' pattern with the selected reagent. SYSTEM EXIT TO DOS ends the session.

0030 0006

' Using up and down arrow keys let the user move through the menu and

40

0030 0006

' the Enter <cr> key activates the selection.

0030 0006

0030 0006 'DATA DICTIONARY

0030 0006

' MENUZ This value represents the current menu item (0-5)

45

0030 0006

' MENU\$(5,1) String array for displaying menu items. 6 rows by 2 columns

0030 0006

' Each row corresponds to a menu item (0-5)

0030 0006

' First column is short menu name in high

50

0030 0006

' lighted area Second column is long description displayed at menu bottom

0030 0006

' ROWNZ(5) This array stores to row in which the short menu name will be displayed

55

0030 0006

' DIFFZ This value is used to change MENUZ in response to arrow keys

0030 0006

' TYPEZ This value is set based on which valid key is pressed

0030 0006

' 0 = No valid key. 1 = Up Arrow. 2 = D

Reagent Jet Printer
Main Line Code

PAGE 2
07-09-86
15:27:04

5

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

10

```

own Arrow. 3 = <cr>.
0030 0006 ' TEMP% Used to store MENU% while screen is ref
reshed
0030 0006 ' A% Used to store single input keystrokes
0030 0006 ' C% Used to store special graphics character
s used in drawing the menu table
0030 0006 ' I% Counter used to refresh display
15 0030 0006 ' R% Row in which special graphics character
is displayed
0030 0006 ' C% Column in which special graphics charac
ter is displayed
0030 0006 REM $PAGE

```

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Reagent Jet Printer
Main Line Code

PAGE 3
07-09-86
15:27:04

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

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```

0030 0006
0030 0006 'Main-line code for RJP Reagent Jet Printer
0030 0006
0030 0006 MAIN.LINE.CODE:
0030 0006
30 0030 0006 GOSUB INITIALIZE
0043 0006
0046 0006 WHILE TYPE% <> 3
0056 0008
35 0056 0008 TYPE% = 0
005D 0008 A$ = ""
0067 000C WHILE A$ = ""
0076 000C A$ = INKEY$
0080 000C WEND
40 0083 000C
0083 000C IF A$ = CHR$(0) + CHR$(72) THEN TYPE% = 1:
up arrow
00A8 000C IF A$ = CHR$(0) + CHR$(80) THEN TYPE% = 2:
down arrow
45 00CD 000C IF A$ = CHR$(13) THEN TYPE% = 3:
<cr> execute command
00E7 000C
00E7 000C ON TYPE% GOSUB T1, T2, T3
00F6 000C
50 00F6 000C WEND
00FA 000C
00FA 000C CLS
0101 000C COLOR 7,0,0
0112 000C SYSTEM
55 0116 000C
0116 000C REM $PAGE

```

		Reagent Jet Printer	PAGE 4
5		Main Line Code	07-09-86
			15:27:04
	Offset	Data	Source Line IBM Personal Computer BASIC Compiler V2.00
	0116	000C	'***** SUB-ROUTINES FOR MAIN PROGRAM
10	0116	000C	T1: 'up arrow
	011B	000C	IF MENUZ = 0 THEN RETURN
	012A	000E	DIFFZ = -1
	0131	0010	GOSUB NEW.MENU
	0137	0010	RETURN
15	013B	0010	
	013B	0010	T2: 'down arrow
	0140	0010	IF MENUZ = 5 THEN RETURN
	014F	0010	DIFFZ = 1
	0156	0010	GOSUB NEW.MENU
20	015C	0010	RETURN
	0160	0010	
	0160	0010	T3:
	0165	0010	ON MENUZ + 1 GOSUB T31, T32, T33, T34, T35, T36
	017C	0010	IF MENUZ < 5 THEN TYPEZ = 0: reset TYPEZ so program
25			won't end
	019E	0010	SCREEN 0,0,3,3
	01A5	0010	RETURN
	01A9	0010	
	01A9	0010	T31: 'pattern definition
30	01AE	0010	CALL PATENTRY: 'in module PATENT
	01BA	0010	GOSUB REFRESH
	01C0	0010	RETURN
	01C4	0010	
	01C4	0010	T32: 'pattern filing
35	01C9	0010	SCREEN 0,0,0,0:CLS
	01E5	0010	CALL PATTERN.FILE: 'in module PATFILE
	01F1	0010	RETURN
	01F5	0010	
	01F5	0010	T33: 'reagent calibration
40	01FA	0010	CALL REAGENT.CALIBRATE: 'in module REACAL
	0206	0010	RETURN
	020A	0010	
	020A	0010	T34: 'reagent filing menu
	020F	0010	SCREEN 0,0,0,0:CLS
45	022B	0010	CALL REAGENT.FILE: 'in module REAFILE
	0237	0010	RETURN
	023B	0010	
	023B	0010	T35: 'print pattern
	0240	0010	CALL PATPRINT: 'in module PATPRINT
50	024C	0010	RETURN
	0250	0010	
	0250	0010	T36: 'exit system, don't reset TYPEZ
	0255	0010	RETURN
	0259	0010	
55	0259	0010	REM \$PAGE

Reagent Jet Printer
Main Line Code

PAGE 5
07-09-86
15:27:04

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0259 0010  NEW.MENU:
      025E 0010      GOSUB MENU.OFF
      0264 0010      MENU1 = MENU1 + DIFF1
      0270 0010      GOSUB MENU.ON
10     0276 0010      RETURN
      027A 0010
      027A 0010  INITIALIZE:
      027F 0010      CALL PCI.INIT
      028B 0010
15     028B 0010      define and initialize arrays
      028B 0010      DIM MROWZ(5)
      028C 0010      MROWZ(0) = 4
      029E 0010      MROWZ(1) = 6
      02B1 0010      MROWZ(2) = 10
20     02C4 0010      MROWZ(3) = 12
      02D7 0010      MROWZ(4) = 16
      02EA 0010      MROWZ(5) = 20
      02FD 0010
      02FD 0010      DIM MENU$(5,1)
25     02FE 004C      RESTORE MENU.STRING.DATA
      0305 004C      FOR IZ = 0 TO 5
      030B 004C          READ MENU$(IZ,0),MENU$(IZ,1)
      033B 004E      NEXT IZ
      034B 004E
30     034B 004E      set initial values into variables
      034B 004E      TYPE1 = 0
      0352 004E      MENU1 = 0
      0359 004E
      0359 004E  REFRESH: redraw screen and highlight current menu selection
35     035E 004E
      035E 004E      SCREEN 0,0,0:CLS:COLOR 7,0,0
      038B 004E      LOCATE 10,32:PRINT "Loading Menu....."
      03A5 004E      SCREEN 0,0,3,0:CLS
40     03C2 004E
      03C2 004E      COLOR 13,0
      03CE 004E      LOCATE 1,3:
      03DB 004E      PRINT "REAGENT JET PRINTER";
      03EB 004E      COLOR 10,0
45     03F4 004E      LOCATE 5,26
      0401 004E      PRINT "PATTERN"
      040E 004E      LOCATE 11,26
      041B 004E      PRINT "REAGENT"
      042B 004E      LOCATE 16,26
50     0435 004E      PRINT "PRINTING"
      0442 004E      LOCATE 20,27
      044F 004E      PRINT "SYSTEM"
      045C 004E
      045C 004E      draw the menu table in special graphics characters
55     045C 004E      COLOR 9,0
      046B 004E      FOR IZ = 18 TO 63
      046F 004E          LOCATE 2,IZ:PRINT "D";
      048A 004E          LOCATE 8,IZ:PRINT "D";
      04A5 004E          LOCATE 14,IZ:PRINT "D";

```

Reagent Jet Printer
Main Line Code

PAGE 6
07-09-86
15:27:04

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      04C0 004E      LOCATE 18,12:PRINT "D";
      04DB 004E      LOCATE 22,12:PRINT "D";
      04F6 004E      LOCATE 24,12:PRINT "D";
      0511 004E      NEXT IZ
10     0524 004E      FOR IZ = 3 TO 23
      052B 004E          LOCATE IZ,17:PRINT "J";
      0546 004E          LOCATE IZ,64:PRINT "J";
      0561 004E      NEXT IZ
      0571 004E      RESTORE TABLE
15     057B 004E      FOR IZ = 1 TO 12
      057F 004E          READ RZ,CZ,C$
      0592 0056          LOCATE RZ,CZ:PRINT C$;
      05AE 0056      NEXT IZ
      05BE 0056
20     058E 0056      print the instructions
      058E 0056      COLOR 7,0
      05CA 0056      LOCATE 25,6
      05D7 0056      PRINT "Use or to highlight menu items. Use to
      activate selection.";
25     05E4 0056
      05E4 0056      COLOR 15,0
      ;
      060A 0056      LOCATE 25,15:PRINT "";
      0624 0056      LOCATE 25,47:PRINT "DY";
30     063E 0056
      063E 0056      display the 6 menu choices
      063E 0056      TEMPZ = MENUZ
      0645 0058      FOR MENUZ = 0 TO 5
      064B 0058          GOSUB MENU.OFF
35     0651 0058      NEXT MENUZ
      0661 0058      MENUZ = TEMPZ
      0668 0058
      0668 0058      highlight the currently active menu item
      0668 0058      GOSUB MENU.ON
40     066E 0058
      066E 0058      SCREEN 0,0,3,3
      0685 0058      RETURN
      0689 0058
      0689 0058      MENU.ON: 'highlight the menu MENUZ and display its long description
45     ;
      068E 0058      COLOR 0,7
      069A 0058      LOCATE MROWZ(MENUZ),52-LEN(MENU$(MENUZ,0))/2
      06DA 0058      PRINT MENU$(MENUZ,0);
      06FB 0058      COLOR 7,0
50     0704 0058      LOCATE 23,40.5-LEN(MENU$(MENUZ,1))/2
      0738 0058      PRINT MENU$(MENUZ,1);
      0757 0058      RETURN
      075B 0058
      075B 0058      MENU.OFF: 'un-highlight menu MENUZ and erase long description
55     0760 0058      COLOR 14,0
      076C 0058      LOCATE MROWZ(MENUZ),52-LEN(MENU$(MENUZ,0))/2
      07AC 0058      PRINT MENU$(MENUZ,0);
      07CA 0058      COLOR 7,0
      07D6 0058      LOCATE 23,40.5-LEN(MENU$(MENUZ,1))/2

```

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Resquest Jet Printer
Main Line Code

PAGE 7
07-09-86
15:27:04

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

30

080A 005B PRINT SPACE\$(LEN(MENU\$(MENUX,1)));
082F 005B RETURN
0833 005B
0833 005B REM \$PAGE

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45

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Reagent Jet Printer
Main Line Code

PAGE 8
07-09-86
15:27:04

```

5      Offset Data   Source Line      IBM Personal Computer BASIC Compiler V2.00

      0833 0058 ***** DATA FIELDS USED BY THE MAIN PROGRAM *****
      0833 0058
10     0833 0058 MENU.STRING.DATA:      'first entry is menu name, second is lo
ng description

      0838 0058
      0838 0058          DATA "DEFINITION", "Create and Modify Patterns"
      083A 0058          DATA "FILING",      "Delete, Copy, Rename, and Select Pa
15     tterns"
      083C 0058          DATA "CALIBRATION", "Calibrate and Modify Reagent Profil
es"
      083E 0058          DATA "FILING",      "Delete, Copy, Rename, and Select Re
20     agents"
      0840 0058          DATA "PRINT",        "Print Selected Pattern with Selecte
d Reagent"
      0842 0058          DATA "EXIT TO DOS", "Leave Program and Return to DOS"
      0844 0058          DATA "EXIT TO DOS", "Leave Program and Return to DOS"
      0844 0058 TABLE: 'first entry is row, second is column, third is special
25     graphics character
      0849 0058
      0849 0058          DATA 2,17,"Z"
      084B 0058          DATA 2,64,"?"
      084D 0058          DATA 8,17,"C"
      084F 0058          DATA 8,64,"4"
30     0851 0058          DATA 14,17,"C"
      0853 0058          DATA 14,64,"4"
      0855 0058          DATA 18,17,"C"
      0857 0058          DATA 18,64,"4"
      0859 0058          DATA 22,17,"C"
35     085B 0058          DATA 22,64,"4"
      085D 0058          DATA 24,17,"8"
      085F 0058          DATA 24,64,"Y"
      0861 0058
      0861 0058          END
40     0865 0058
      0842 0058

```

50426 Bytes Available
47680 Bytes Free

0 Warning Error(s)
0 Severe Error(s)

50 Claims

1. A dispensing system for use in diagnostic instruments for precise metering of a desired diagnostic fluid, the system comprising:
 - 55 a jetting chamber defining a volume and comprising a first and second aperture, the first aperture adapted to receive diagnostic fluid, the second aperture defining an orifice;
 - a transducer in mechanical communication with the jetting chamber, the transducer operative to alternately expand and de-expand the volume of the jetting chamber in response to a selected electrical pulse and

thereby cause the jetting chamber to omit a substantially uniformly sized droplet of diagnostic fluid through the orifice; and

means for generating a number of electrical pulses sufficient to cause a desired quantity of the diagnostic fluid to be dispensed.

5 2. The invention of Claim 1 wherein the system further comprises:

at least one additional jetting chamber in fluid communication with an additional diagnostic fluid;

at least one additional transducer in mechanical communication with the additional jetting chamber;

at least one additional means for applying an electrical pulse to the additional transducer;

10 means for generating respective numbers of electrical pulses sufficient to cause precise quantities of the diagnostic fluids to be dispensed in a desired volumetric ratio; and

a receptacle adapted for and positioned to receive the fluids.

3. The invention of Claim 1 wherein the system further comprises:

means for directing at least one of (1) the receptacle and (2) the emitted diagnostic fluid and the emitted additional diagnostic fluid such that desired quantities of the fluids are dispensed into the receptacle in a

15 predefined dispensing order.

4. The invention of Claim 1 wherein one of the diagnostic fluids comprises serum and wherein the jetting chambers cooperate such that the other diagnostic fluid is emitted in a manner to contact and mix with the serum.

5. The invention of Claim 1 wherein the jetting chamber comprises a cylindrical tube and wherein the transducer is mounted concentrically about the cylindrical tube.

6. The invention of Claim 1 wherein the jetting chamber is conically shaped.

7. The invention of Claim 1 wherein the jetting chamber comprises at least one chamber wall which is integrally formed with the transducer.

8. The invention of Claim 1 wherein the transducer is one of (1) a piezo-electric transducer; (2) a magneto-strictive transducer; (3) an electro-strictive transducer; and (4) an electro-mechanical transducer.

9. The invention of Claim 1 wherein the jetting chamber is conically shaped; and wherein the transducer is disc shaped and forms the base of the conically shaped jetting chamber.

10. The invention of Claim 1 wherein the orifice comprises an end face and the end face is coated with a hydrophobic polymer.

30 11. The invention of Claim 1 wherein the transducer is cylindrically shaped and comprises a first electrode located on the inner wall of the cylinder and wraps around one end of the cylinder and wherein a second electrode is located substantially on the outer wall of the cylinder and is electrically isolated from the first electrode.

12. The invention of Claim 1 wherein the means for generating produces an electrical pulse of selected rise and fall time constants and of selected duration, voltage and polarity.

13. The invention of Claim 1 wherein the means for generating the electrical pulse comprises means for scaling the voltage of the pulse in response to a selectable digital value.

14. The invention of Claim 1 wherein the apparatus further comprises means for directing the emitted diagnostic fluid along a desired path.

40 15. A method of dispensing precise quantities of diagnostic fluids comprising the steps of:

(a) generating an electrical pulse of predefined characteristics;

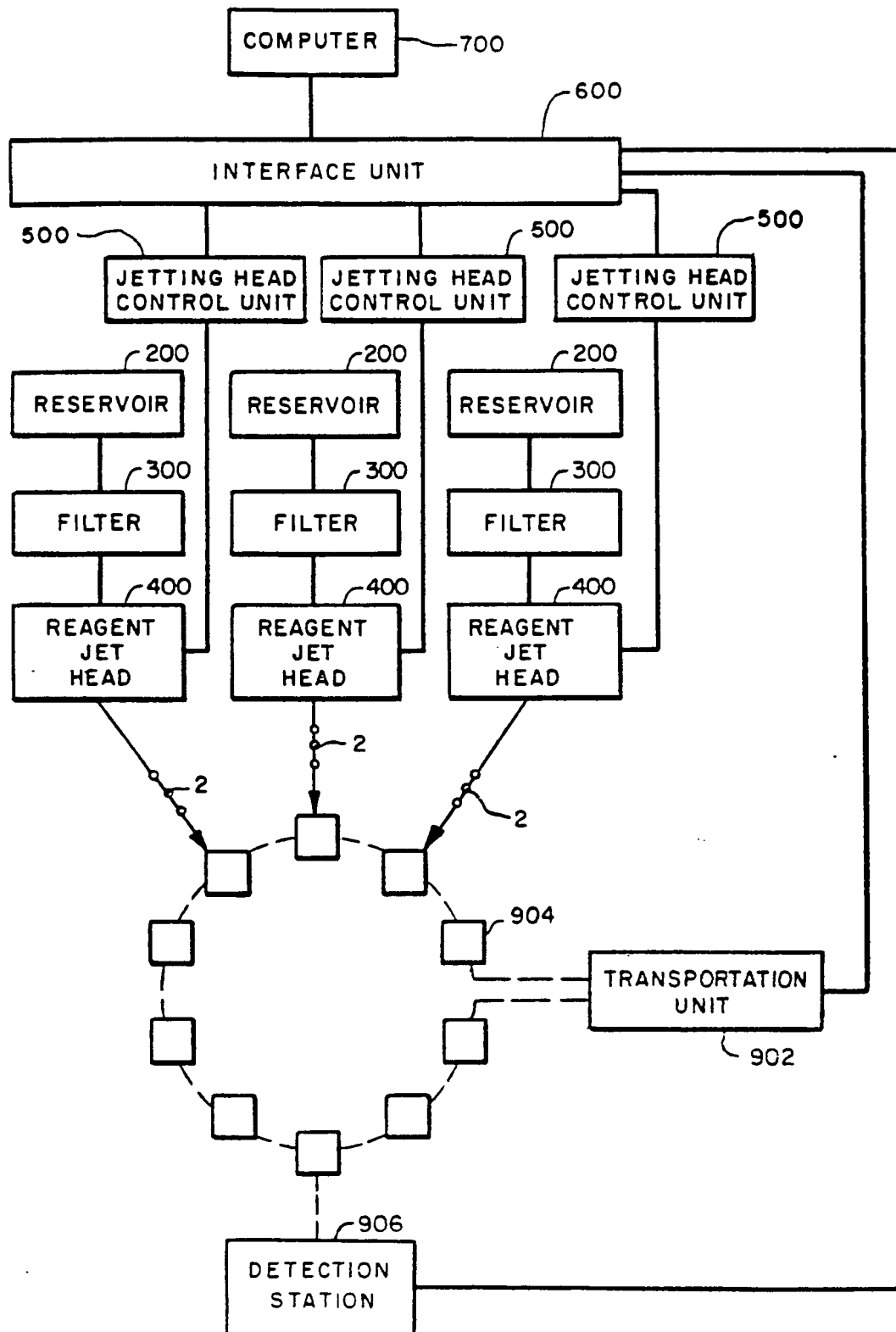
(b) reducing the volume of a chamber containing the diagnostic fluid by electro-mechanical means in response to the electrical pulse such that a droplet of fluid of known volume is propelled through an orifice in the chamber; and

45 (c) repeating steps (a) and (b) until a desired quantity of the diagnostic fluid has been dispensed

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FIG. 1



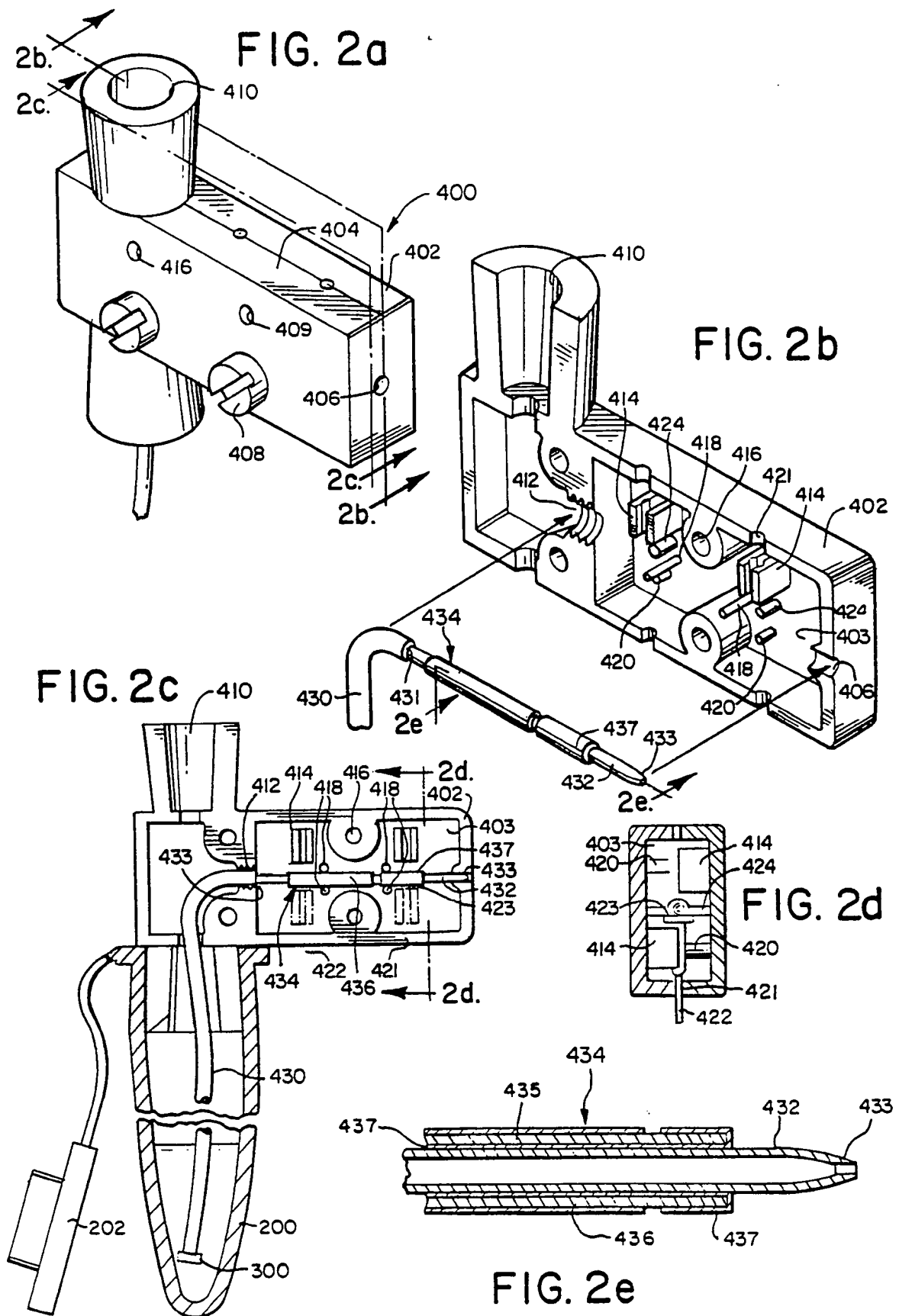


FIG. 3

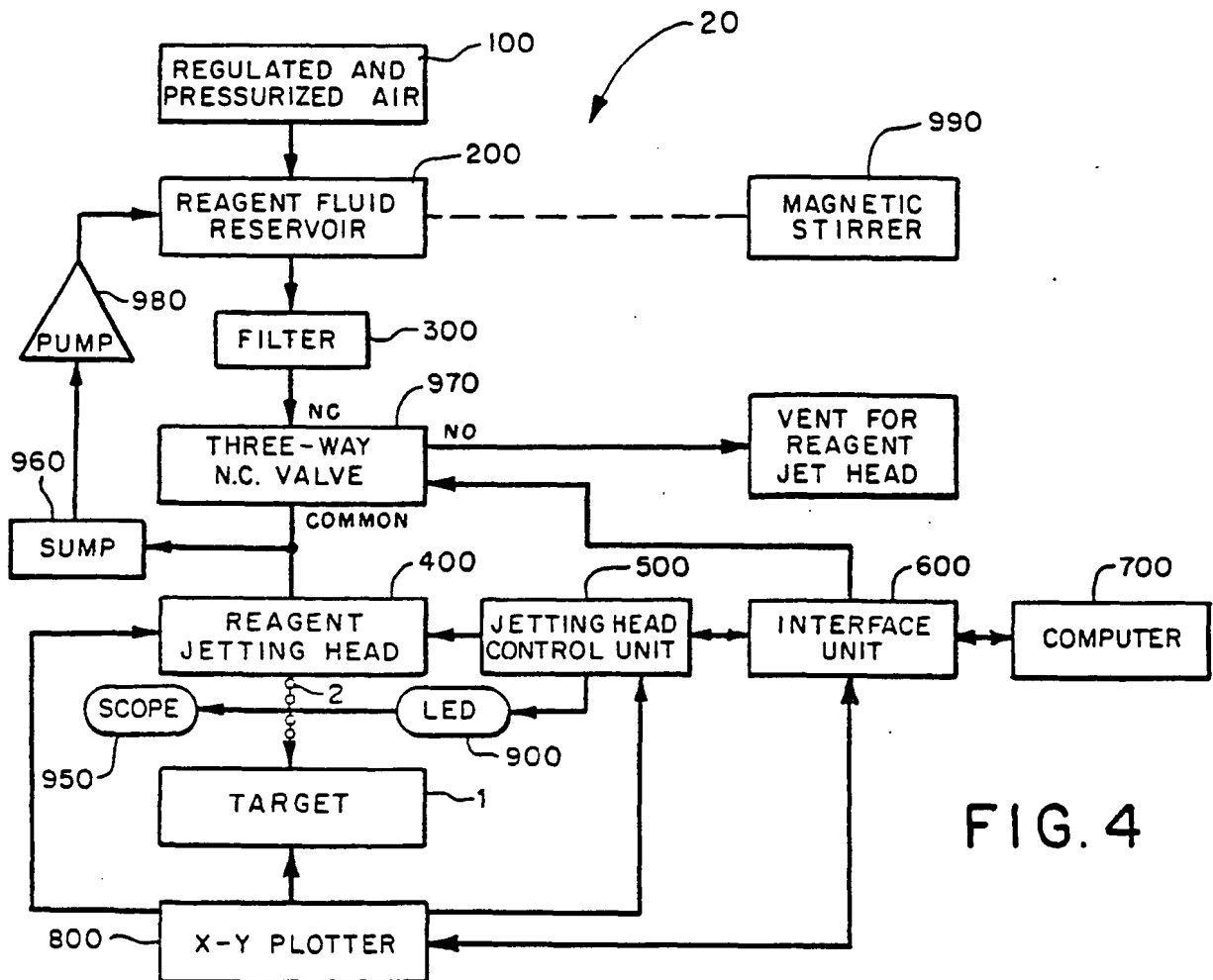
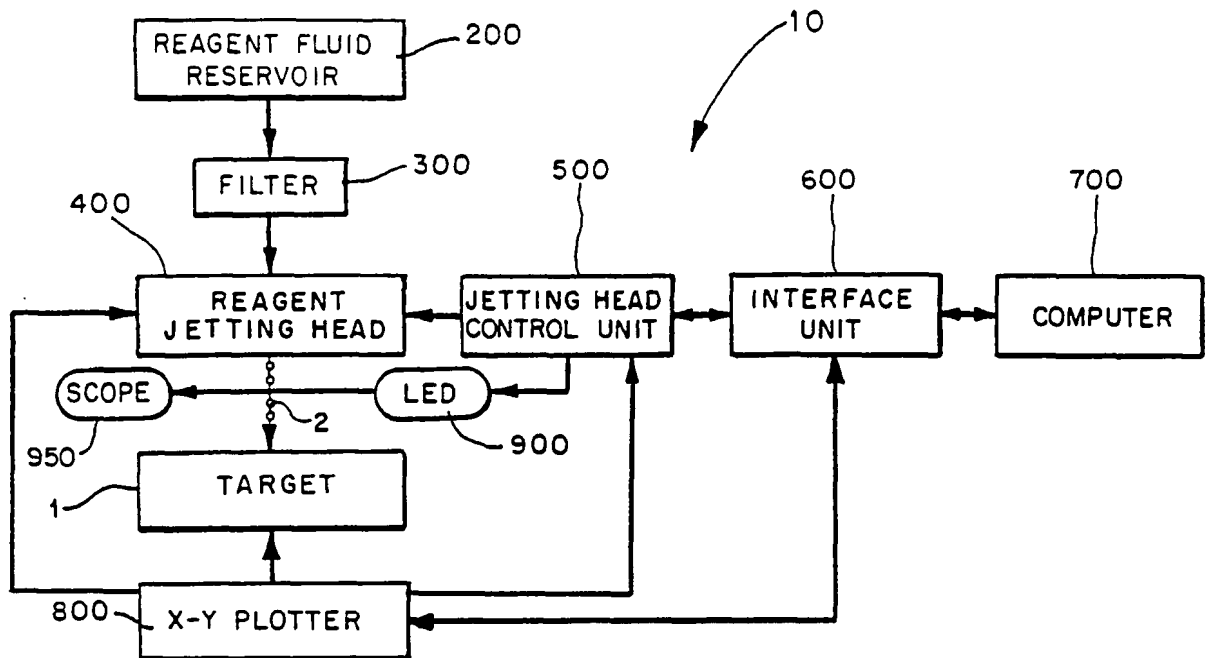


FIG. 4

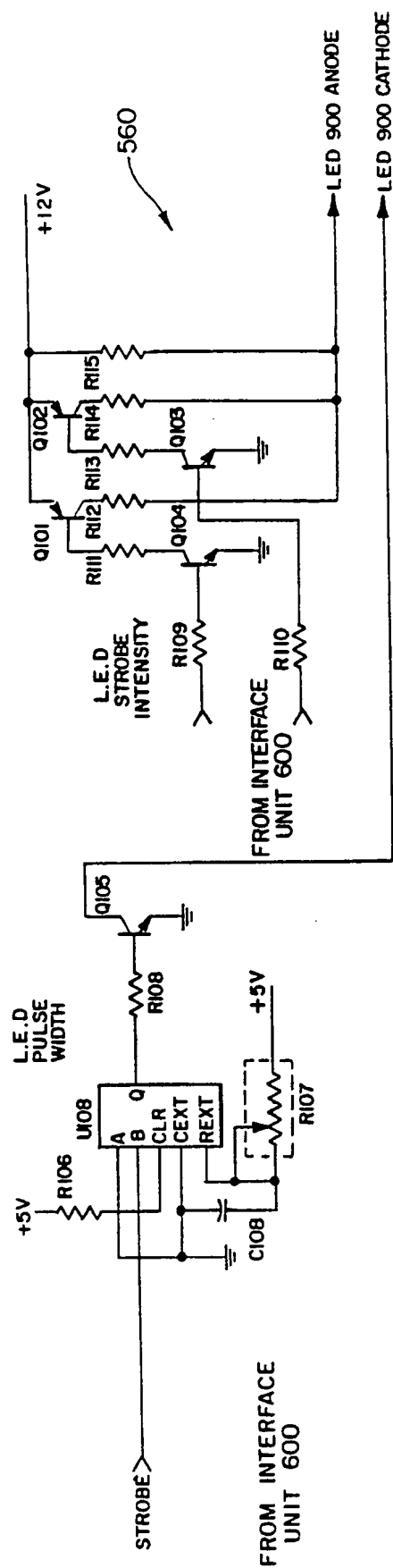


FIG. 5a

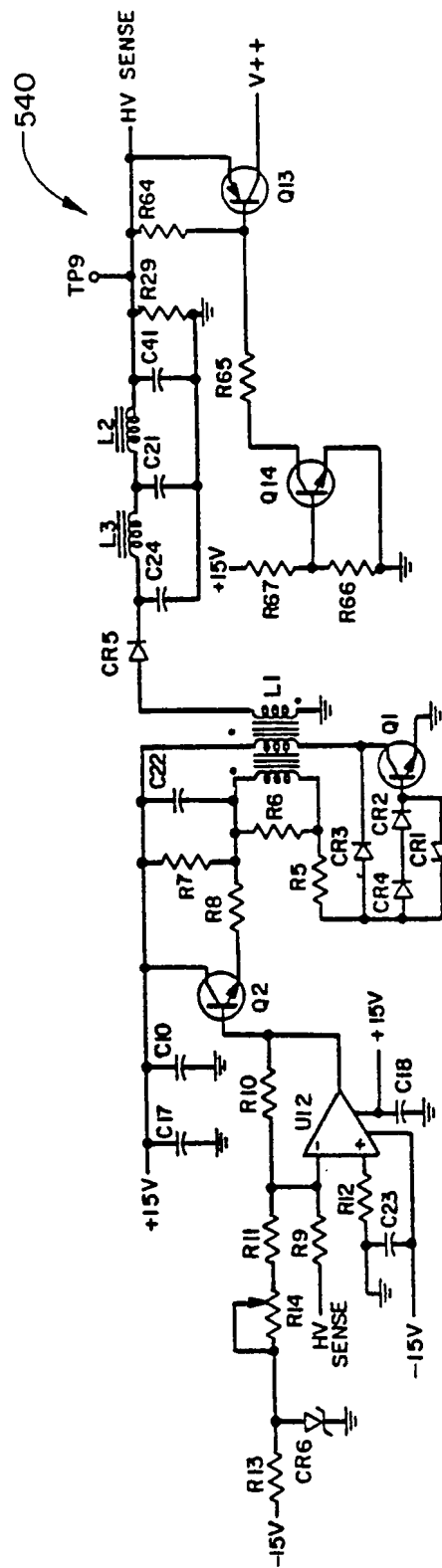


FIG. 5b

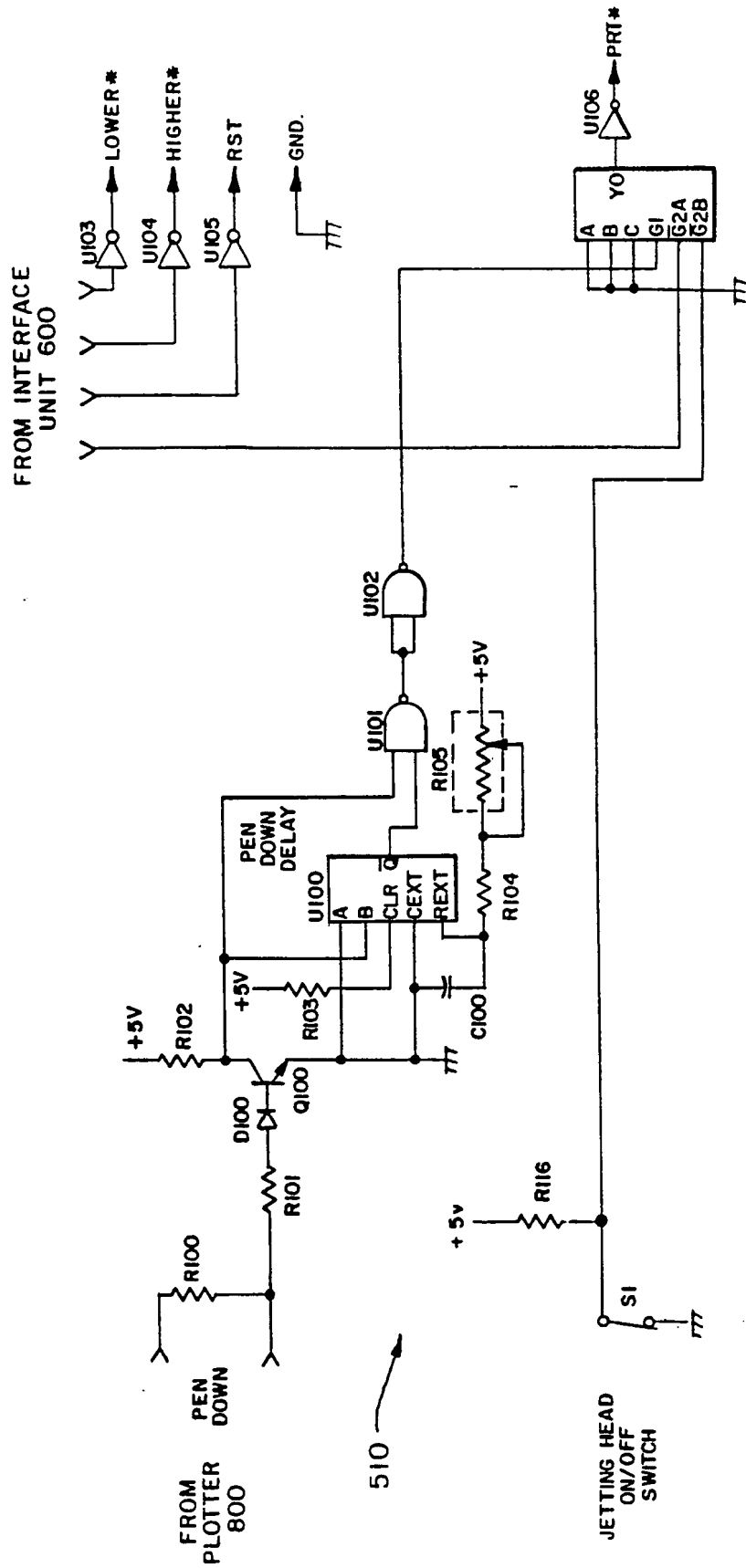


FIG. 5c

FIG. 5d

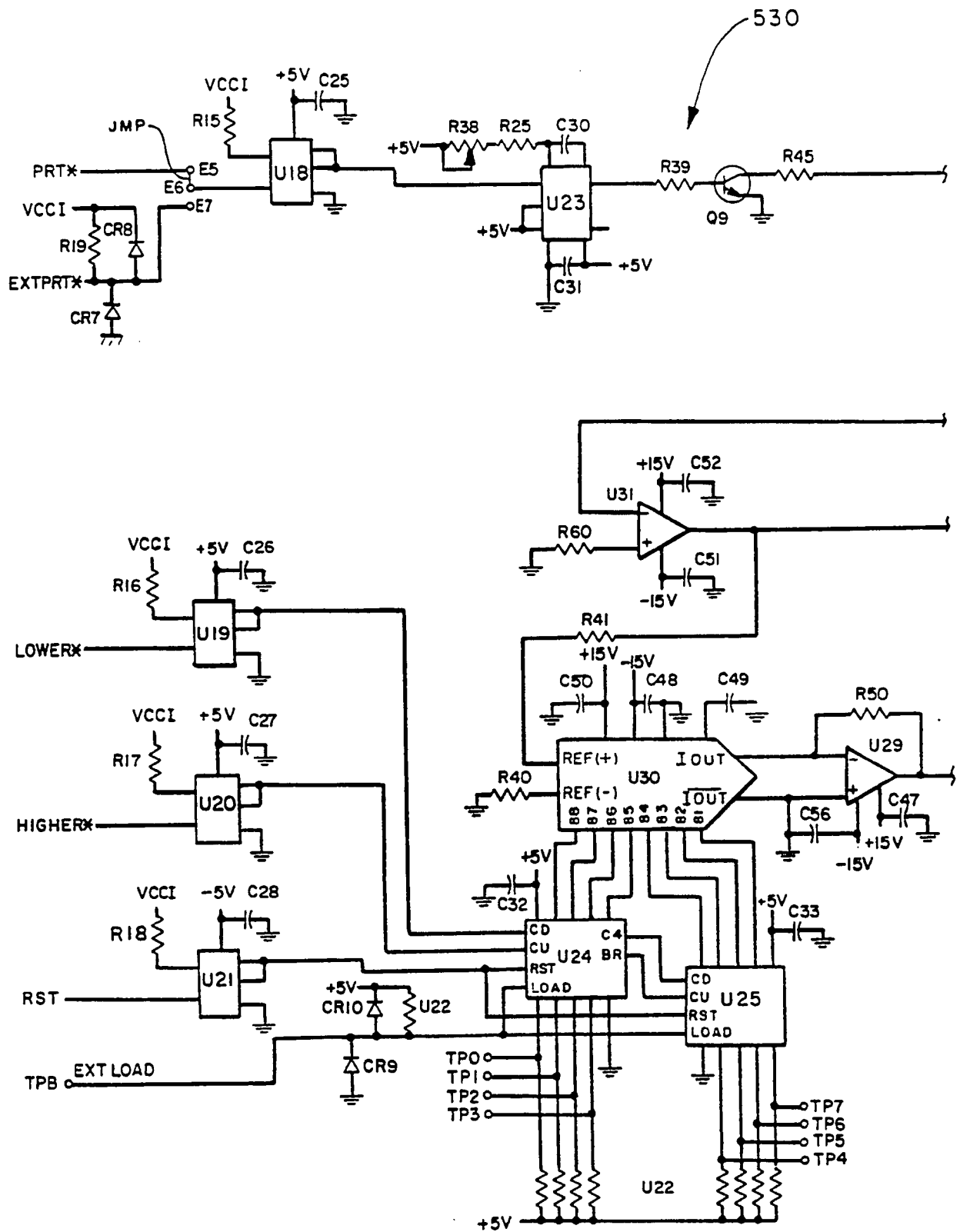


FIG. 5e

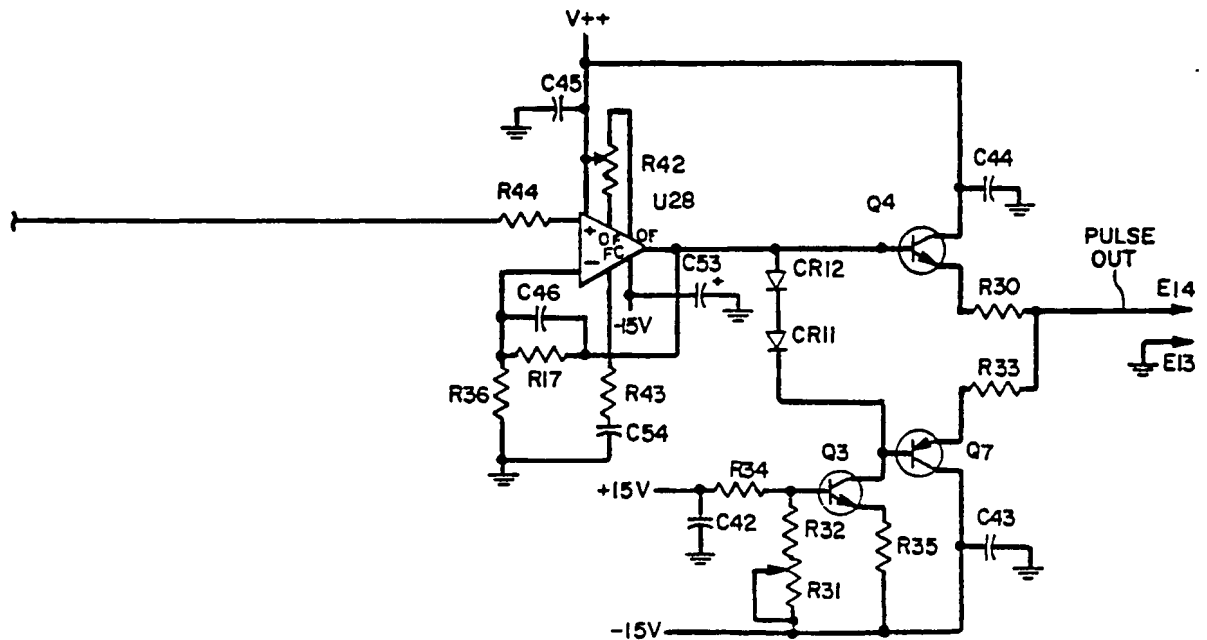
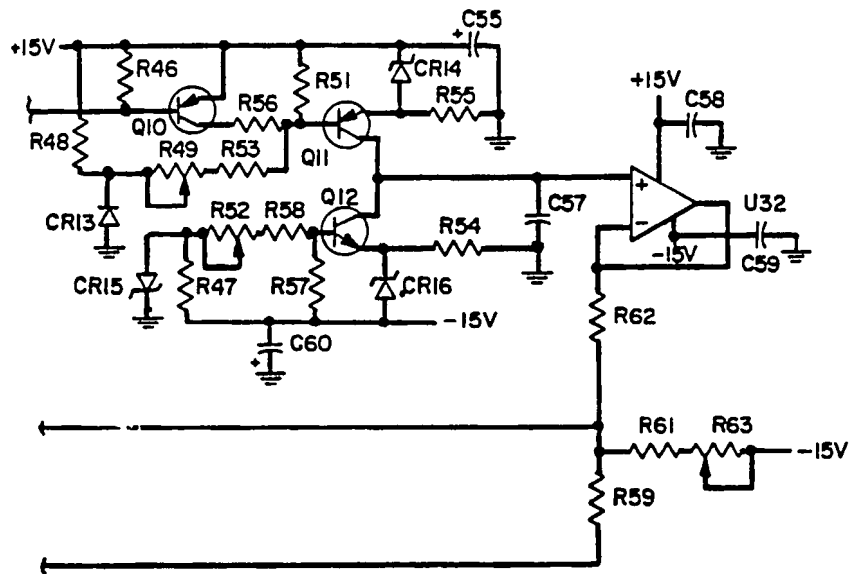


FIG. 6a

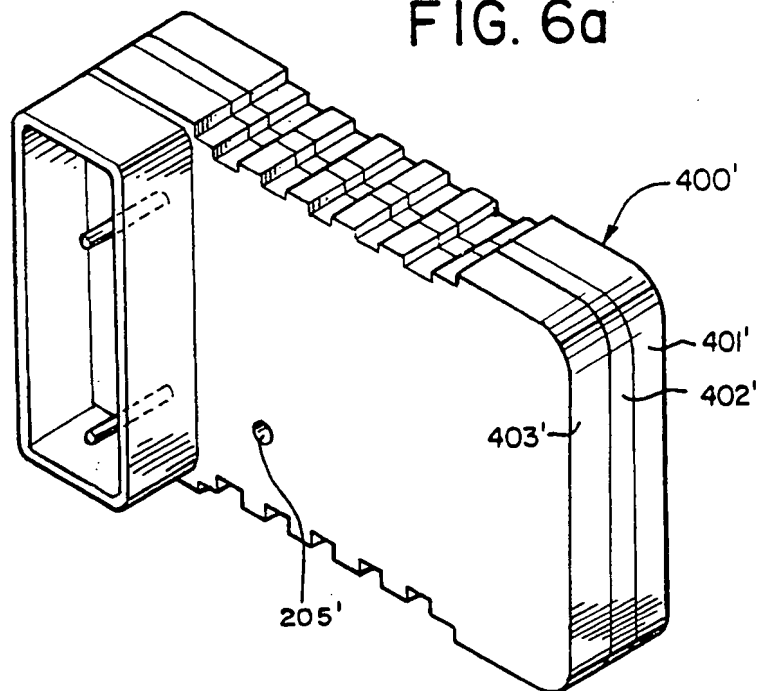


FIG. 7

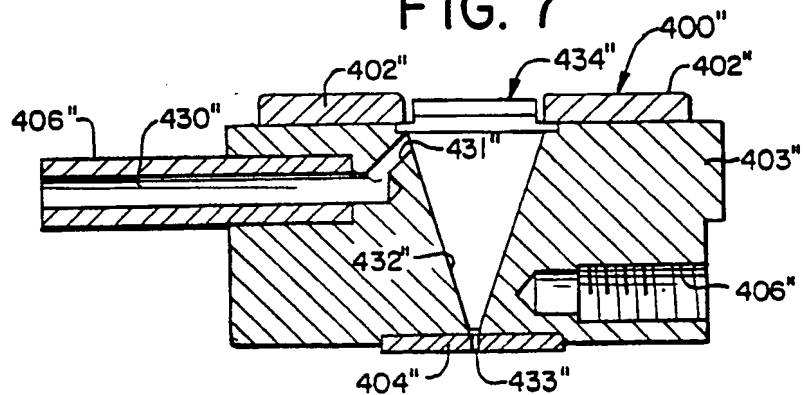
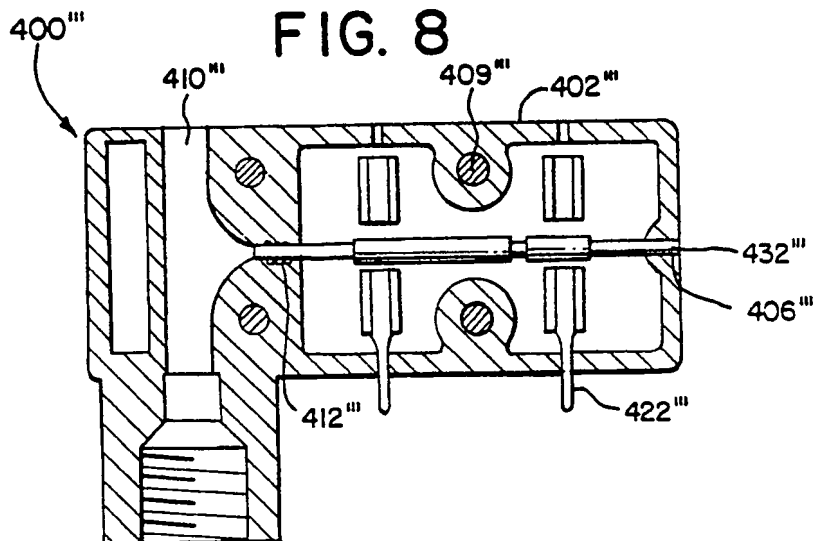
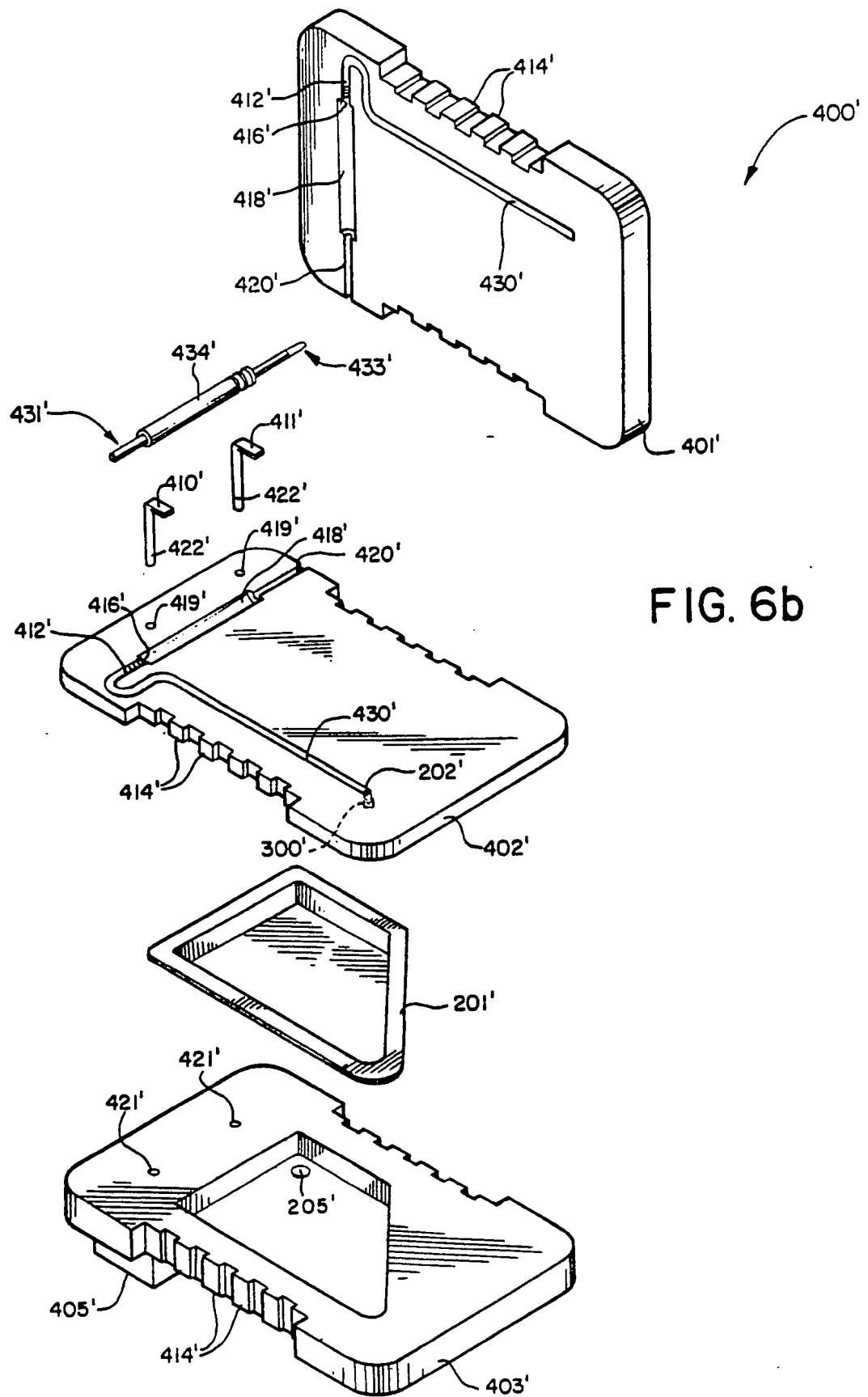


FIG. 8





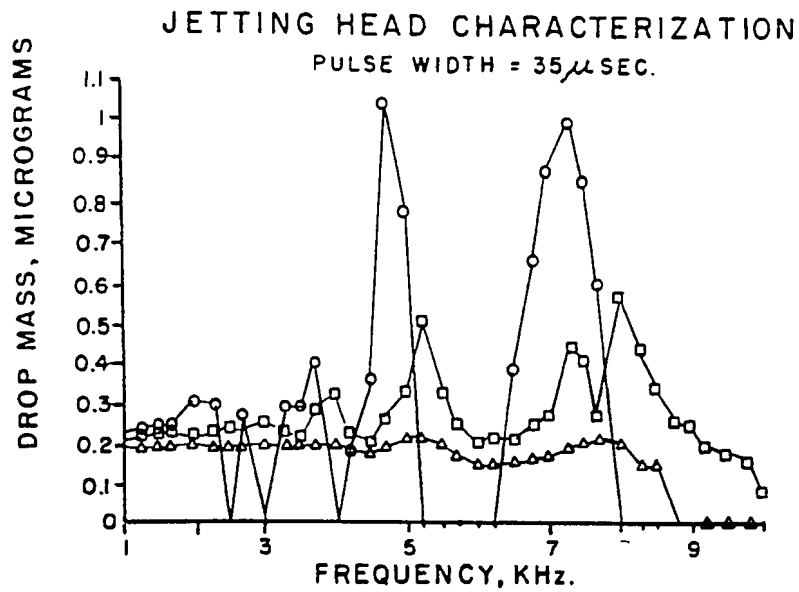


FIG. 9

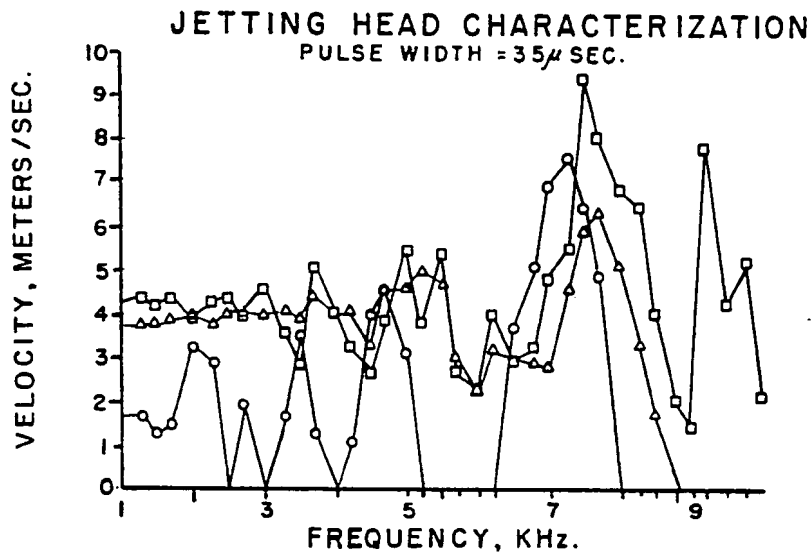


FIG. 10

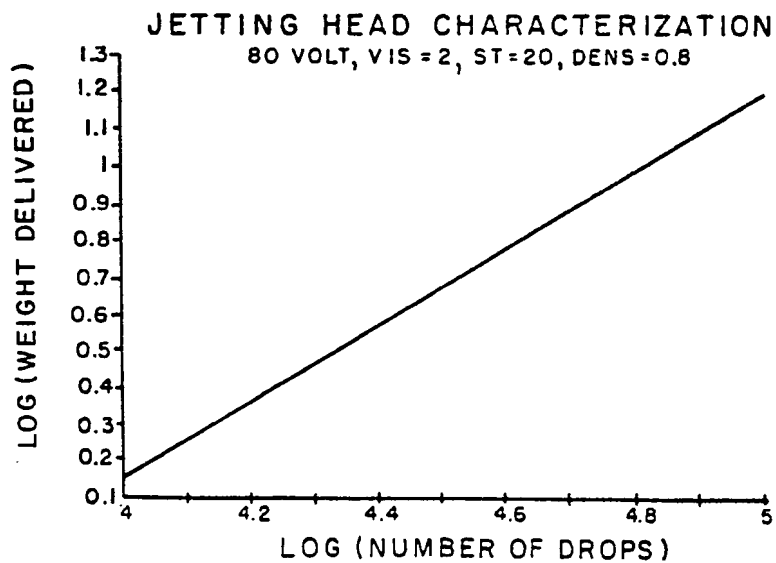


FIG. 11